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February 6, 2014

The Honorable Bill Botzow, Chairman
House Committee on Commerce and Economic Development
State of Vermont
House Chamber
Montpelier, Vermont

The Honorable Tim Ashe, Chairman
Senate Committee on Finance
State of Vermont
Senate Chamber
Montpelier, Vermont

Dear Representative Botzow and Senator Ashe:

The Department of Public Service respectfully forwards the attached Volume III of the Universal Service Fund Report, entitled "Universal Service Goals and Policy Options," in fulfilment of the Department's obligations under 30 V.S.A. § 7515 (b). The purpose of this report is to inform the Legislature about various universal service considerations as your committees take up the subject of universal service reform. The Department notes that the views, opinions, and recommendations contained within this report are strictly those of the authors, and do not represent the position or preferred policy direction of the Department.

The Department would also note that the authors of this report, selected due to their familiarity with the Vermont Universal Service Fund, serve as the fund administrator for the Vermont Universal Service Fund. While the Department has no reason to believe the authors' position as fund administrator affected the outcome of this report, the Department believes this fact should be noted in the interest of full disclosure.

If you have any questions about the Phase III report, please do not hesitate to call me at (802) 828 – 4003.

Sincerely,

Jim Porter
Senior Policy and Telecommunications Director

Vermont Universal Service Goals and Policy Options

Volume 3 of a Report to the Vermont Department of Public Service

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February 6, 2014

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Executive Summary

This report was prepared by Rolka Loube Saltzer Associates (RLSA) under contract to the Vermont Public Service Department. The report responds to a 2012 Vermont statute that required a study of the costs and other factors affecting the delivery of local exchange service by the incumbent local exchange carriers. This report is Volume III of a trilogy that covers a variety of policy issues mentioned in the Vermont statute that have not been discussed in the two previous reports.

In Volume I, we found that the FCC's recent *USF/ICC Transformation Order* created serious financial problems for the Vermont ILECs. Individual companies aside, however, the FCC's actions were only one of many events likely to reduce ILEC revenues and create financial instability. In Volume II we forecast the overall financial position of the Vermont ILECs, and we found that nearly all stand to lose money this year and in the immediate future, both on a regulated activities basis and on an all-in basis. We saw no basis to conclude that gloomy picture was likely to change.

Universal service is a cornerstone of telecommunications policy in the United States. The FCC and state commissions historically have worked together to promote universal service. Forty-four states and the District of Columbia have universal service funds of various kinds, including high-cost, lifeline, schools and libraries, and other types of funds. Twenty-one of those have high-cost funds.

Since 1994, Vermont has had a Universal Service Fund, but until 2013 it never provided high-cost support to any telecommunications carriers. The original task of supporting universal service has changed fundamentally, due to changes in technology, in the law, in the operation of markets, and in regulatory policy. Nevertheless, the "rural divide" exists in Vermont, possibly even more so than in less rural states. It means that urban and suburban areas of the state have more facilities-based competition and better broadband service than do the state's rural areas.

Volume I of this report documented anticipated changes that the FCC is making to ILEC revenue streams, mostly in the form of changes to universal service mechanisms and reductions to carrier-to-carrier charges. In Volume II we estimated that these and other industry changes should lead to incumbent local exchange carrier (ILEC) operating losses of about $40 million in 2013. We found little reason to believe this situation will improve in the coming years. If events match our estimates, the future of telecommunications in Vermont is likely to be turbulent. The possibility of a financial failure by an ILEC is particularly troublesome because neither state nor federal law explains clearly how state or federal officials would protect customers and other carriers during and after that event.

We conclude that the deteriorating financial status of Vermont's ILECs, combined with the probability of insufficient FCC support, could greatly disturb the current universal service landscape. In the face of such change, a new high-cost USF program is one option. The alternative is to rely on competitive wireline providers, wireless and satellite technology to fill any gaps that might develop in the ILEC wireline network and to accept the risk that some currently served areas might lose wireline service.

This report reviews the economic literature on how telecommunications markets function.

- We found there is seldom a threshold rate level beyond which universal residential service is likely to be harmed.
- We found that the stand-alone, the bundled service, and the wireless sub-markets are less than fully competitive and that inter-platform competition is geographically limited. We do not recommend that Vermont rely solely on competition to ensure that customers receive uniform and affordable basic telecommunications service.
- We did not find any academic research that related economic development to the level of basic telecommunications service charges. We did find some evidence that states and countries that invest in broadband do benefit from increased economic growth.

This report suggests a number of principles to use in designing a high-cost universal service program. These include:

- Support should be effective at maintaining and expanding the availability of essential services.
- Rates should be affordable so that a household earning the Vermont median family income can afford a telecommunications package that allows the family to participate fully in society.
- Support should be sufficient to the task of ensuring service remains available everywhere in the state, but no more. This means that VUSF high-cost support calculations should consider all the costs incurred and revenues earned by the network operations of the supported carrier and its affiliates.
- VUSF support should be subject to budgetary limits set by law. This goal will likely require compromises with other goals, such as reliability and ubiquity.
- Support should create incentives to discourage waste but also to encourage adequate maintenance and network modernization.
- Uniform economic development should be a goal for universal service support.

The report suggests that Vermont consider a number of threshold policy issues in conjunction with designing a high-cost support mechanism. These include:

- Whether the goal is to make service available in 100% of the business and residential locations in Vermont.
- Whether the definition of essential service should include both broadband and voice.
- The minimum speed for supported broadband service.

- Whether wireless service can meet Vermont's universal service standards in some or all parts of the state. Ideally, this decision would be made after consideration of such issues as ubiquity, convenience, network congestion, future capacity, atmospheric reliability, disaster resistance, reasonable rates, and the effects of wireline abandonment.
- Whether satellite service can satisfy Vermont's universal service standards in some or all of the state.
- Whether both ILECs and cable television companies will be eligible for support, provided they accept appropriate universal service obligations in geographically mixed zones.
- Whether to charter any new municipal telecommunications systems.
- How to support the low-cost and often competitive "donut holes" that exist within many telephone exchanges.
- Whether to provide support for some of the costs of privately acquired capital, and if so, how to adjust support for past contributions of public capital.
- How to define rate standards for various bundles of service, including basic telephone service (dial tone), bundled voice with toll, and broadband.
- Whether to authorize or prohibit rate deaveraging as a means of meeting budgetary goals.
- Whether to enlarge the VUSF contribution base so as to require contributions from broadband providers and customers.

The report reviews three kinds of support mechanisms. Vouchers (or customer credits) make program benefits visible to customers, but create risks of inefficiency, ineffectiveness, overpayment, and complexity. The most serious risk is of a vicious cycle in which carriers raise gross rates, hold net bills to customers constant, and increase claims for VUSF support.

Broadening the existing Lifeline program is another option. This option uses a means test for benefits and therefore provides no benefit for many customers. A broader Lifeline program could be administratively simple if broadband is not covered. However, if broadband is covered, the existing program would need to be redesigned fundamentally, and it is not clear what kinds of providers would participate. A Lifeline mechanism would also fail to address economic development, because the benefit flows only to low-income residential customers. Finally, Lifeline seems intrusive to customers because it requires income disclosure, and it can create a substantial burden on the state and on providers who must periodically recertify eligibility of individual customers.

The final option considered in the report is the business-model-based support mechanism. The goal of the mechanism is to allow the supported provider, after considering competitive conditions, to implement a plausible business plan that creates a reasonable opportunity to obtain private capital and to earn a reasonable profit.

In a competitive market, a business-model-based support mechanism is an appropriate replacement for the more traditional cost-based mechanism. Both mechanisms estimate cost. The crucial difference is that a business-model-based mechanism also estimates revenue. Any such mechanism would need some constraints on accounting or embedded costs, possibly by using a forward-looking cost model. Likewise, there would need to be revenue constraints that impose reasonable expectations for revenue, including subscriber revenue and federal USF support, and that reflect competitive conditions.

The final section of the report discusses support for competitive carriers. A competitively fair high-cost mechanism should give all competitors equal opportunity to receive support, but should require them to assume equal service obligations. Nevertheless, we recommend that Vermont restrict VUSF payments in any geographic area to a single provider. We recommend rejecting auctions as a potential support mechanism. We do, however, suggest a procedure by which support could be transferred to a single successful challenger that would displace the incumbent carrier but would also be subject to standard carrier of last resort obligations.

We hope the three volumes of this report have provided the Vermont Legislature with sufficient information to efficiently structure a debate on creating a high-cost support mechanism.

Contents

I. Background – Universal Service in 1994 and 2013

This is the third volume of a report prepared by Rolka Loube Saltzer Associates (RLSA) under contract to the Vermont Public Service Department. The report responds to a 2012 Vermont statute[1] that required a study of the costs and other factors affecting the delivery of local exchange service by incumbent carriers. This report covers a variety of policy issues mentioned in the Vermont statute that were not discussed in the first two volumes.

A. The Concept of Universal Service – Vermont History

Universal service is a cornerstone of telecommunications policy in the United States. Most citizens of the country simply assume, and commonly rely upon, the fact that we all can reach each other at work and at home through the landline telephone network, through mobile wireless networks, and through the Internet. This allows us to communicate frequently with each other, to conduct business, and to reach important commercial and government services.

Universal service has evolved over time. As recently as the 1990s, universal service was commonly understood to mean widespread availability of landline telephone service at affordable rates. Defined this way, universal service has been a great success in the United States. Telephone penetration increased in the United States steadily from 37% in 1940 to a peak of 98% in 2008.[2]

The FCC and state commissions historically have worked together to promote universal service.[3] The concept was a central tenet of the federal Communications Act passed in 1934.[4] Until the next revision of the Communications Act in 1996, universal service policies guided the FCC in many ratemaking decisions, particularly during the 1960s and 1970s, when the main

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[1] 30 V.S.A. § 7515(b).

[2] Telephone "penetration" is defined as the percentage of occupied housing units with telephone service. "Penetration" can also be defined as the percentage of households with telephone service. FCC, CC Docket No. 96-45, *Universal Service Monitoring Report for 2012,* Table 3.4. Low-income people have fewer telephones. In 2012, 98% of higher-income households had telephone service, but only 92% of low-income households (below $10,000) had telephone service. *Id.*, Table 3.2. Also, people in southern states have slightly fewer telephones than people in northern states. In 2011 the eleven states on the U.S. border with Canada had an average telephone penetration of 97.2%. The eight states on the southern border had an average telephone penetration of 95.3%. *Id.,* Table 3.7; author's calculations.

[3] In addition, the Rural Utility Service provided loans to extend telecommunications service in many rural areas.

[4] Section 1 of the Communications Act of 1934 authorizes the Federal Communications Commission (FCC) to regulate interstate and foreign communications "so as to make available, so far as possible, to all the people of the United States a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges." 47 U.S.C. 151 (1988)

policy objective was to keep rates low for local exchange service.[5] In the 1980s, the FCC began providing explicit universal service support to incumbent local exchange carriers (ILECs), and those federal programs later proliferated.

The federal Telecommunications Act of 1996 gave universal service a central place in federal policy. It established policy principles regarding universal service, such as that "quality services should be available at just, reasonable, and affordable rates" and "access to advanced telecommunications and information services should be provided in all regions of the Nation."[6] Notably, the Act articulated for the first time the statutory obligation of the FCC and the states to provide "sufficient" support so that services in rural areas are "reasonably comparable" to services in urban areas.[7]

Forty-four states and the District of Columbia have universal service funds of various kinds, including high-cost, lifeline, schools and libraries, and other types of funds. Twenty-one of those have high-cost funds.[8]

Universal service has been a mainstay of Vermont policy for 20 years. In 1994, the Vermont Legislature enacted legislation creating the Vermont Universal Service Fund (VUSF). At the time, the main purpose of the new VUSF was to fund new Enhanced-911 (E-911) services.[9] The VUSF also pays the costs associated with the state's Lifeline, Linkup, and Relay[10] programs.

The 1994 Legislature created a statutory placeholder for a "high-cost" funding mechanism, but it did not actually authorize any spending of this kind. Instead, the Legislature called for a study, which the Public Service Board delivered in 1996. The PSB's report

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[5] Before the mid-1980s, the FCC assumed increasing shares of the telephone network's overall costs in order to keep local exchange rates low. But in the mid-1980s the FCC began to place greater emphasis on reducing interstate telephone rates. To do this, the FCC moved costs back to the intrastate side by freezing and then reducing the gross allocator, which had greatly benefitted small states like Vermont. The FCC also changed the allocation of circuit switching equipment and the amortization rules for old switches.

[6] See 47 U.S.C. § 254(b)(1), (2). The FCC has drawn a sharp distinction between telecommunications and information services. Broadband, according to federal law, is the latter. In this report we frequently refer to both voice service and broadband service as "telecommunications."

[7] See 47 U.S.C. §§ 254(b)(5), (d), (e).

[8] Sherry Lichtenberg, et.al., *Survey of State Universal Service Funds 2012,* National Regulatory Research Institute, 2012, p. 3.

[9] Before 1994, Vermont had 911 service but not statewide Enhanced-911.

[10] Lifeline is a discount program that helps pay monthly rates for Vermonters with low incomes. Linkup is a discount program that helps pay for the connection costs of Vermonters with low incomes. Relay is a program that provides various forms of assistance, including sign language interpreting, for persons who are deaf or hearing impaired.

recommended creation of a high-cost fund; but the 1997 Legislature did not authorize any such program. The statutory placeholder remained untouched, and today's VUSF continues to provide funding for several programs, but not high-cost support.

B. Technology Changes

When the Vermont Legislature created the VUSF in 1994, voice service was the only plausible definition of an "essential" telecommunications service. Nearly all Vermont households subscribed to landline voice service from the traditional telephone company,[11] and the service was mature and well defined. Since then, the technology of telecommunications, the legal and market backgrounds of the telecommunications business, and its funding and regulatory constraints have all changed. Each change has complicated both the telecommunications market itself and the design of any effective high-cost universal service mechanism.

This section summarizes the relevant changes to telecommunications technology since 1994, with emphasis on how they affect the design of a modern state USF program.

1. Lower Costs

Telecommunications technology has changed continually throughout the last 150 years. In the 1990s, Vermont policymakers thought they were experiencing rapid change. The decade saw the introduction of digital programmable electronic switches and the new services those switches could support, such as caller ID, call waiting, and voicemail.

After 1994, the pace of change only increased. Moore's Law[12] is at the root of many of these changes, because it has reduced the price for all kinds of electronics, including central office telephone equipment. A soft switch today can handle the same work that took a whole wall of computers to achieve in 1994, but at a fraction of the cost and space required. More important, Moore's Law has allowed processing functions to be distributed into computers and smartphones, greatly reducing the importance of central offices and making telecommunications networks less hierarchical.

Advances in light fiber technology have been equally important, first in reducing long-distance costs and later in providing high-capacity local lops.[13] Today, ILECs can install fiber

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[11] In 1996, 95.9%of Vermont households had telephone service. FCC, *1997 Monitoring Report*, Table 1.2.

[12] Moore's Law states that the number of transistors on integrated circuits doubles every two years. Following the 1984 ATT divestiture, competition in switch manufacture allowed these greater efficiencies to percolate into the ILEC network.

[13] In the 1980s, long-distance competitors began installing the new fiber technology for interoffice cables, and they used digitized (rather than analog) voice transport. This increased the fidelity of sound

directly to subscriber locations using fiber-to-the-home (FTTH) technology, and sometimes these FTTH cables cost less than copper.

Network protocols have also changed. In the early 1990s, the Public Switched Telephone Network (PSTN) and the Internet were almost entirely separate networks. The PSTN was centrally controlled and used packets only incidentally.[14] The Internet existed, but before the late 1990s it was mainly an academic curiosity. Today, packet-based networks dominate virtually all telecommunications networks, including those used for voice.

Internet Protocol (IP) is the hands-down winner among packet technologies. IP technology is almost exclusively used for data today, and it is increasingly used for voice traffic. IP technology is not only used on the public Internet but also on many PSTN networks that carry voice traffic. Larger telecommunications companies typically have nationwide or even worldwide "managed" IP networks, distinct from the public Internet, which they use for both voice and data. Finally, the boundary between the PSTN and the Internet has blurred, with information of all kinds routinely moving back and forth.

All of these technological changes have reduced telecommunications costs, whether for the equipment that sits in central offices and at remote platforms in rural areas, or by increasing transport efficiencies. Unfortunately, none of these changes have greatly reduced costs in rural areas that have long loops connecting customers to central offices. Many of those costs have actually increased, including for copper wire and for labor. In Volume II of our report, we described the forward-looking costs of providing service in all the exchanges in Vermont. The results confirm that the cost of serving rural areas is still high, even after many years of declining costs in the industry.[15]

2. Mobile Wireless Networks

Wireless service has proven itself to be far more successful than seemed likely in 1994. There are two varieties of wireless networks, fixed[16] and mobile. Fixed wireless operates from fixed tower antennas to fixed equipment at a customer location. Mobile wireless uses fixed antennas, such as cell towers, but the terminating device can be handheld and moved from one location to another.

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transmission on the competitive networks and created pressure for the ILEC industry to also adopt the newer technologies.

[14] The telephone network early developed some of its own packet-based protocols and services, such as ATM and frame relay.

[15] We used the same model that the FCC used 13 years ago, but with new inputs reflecting current market prices.

[16] Fixed wireless providers are often called wireless internet service providers (WISPs).

Mobile wireless subscribership has grown geometrically for most of the last two decades. The wireless industry now uses far more telephone numbers than wireline.[17] Many households have cut the cord: half of all U.S. adults live in households that either only have wireless phones or have both but mostly use the wireless.[18] Today 85% of U.S. adults own a cellphone, and 29% of cell owners describe their cell phone as "something they can't imagine living without."[19]

Wireless is not equally popular for all customer groups. Age strongly affected the results, and 60% of adults aged 25 to 29 are wireless-only consumers. [20] Adults renting their homes are more likely to live only with wireless phones.[21] Low-income people rely more on wireless.[22] Regionally, the South is more reliant on wireless, and the Northeast less so.[23]

Mobile wireless companies offer third-generation (3G) and fourth-generation (4G) data services that are accessible over smartphones that compete with wireline broadband. By June 2013, 56% of American adults owned a smartphone. Smartphones are particularly popular with young adults[24] and in higher-income households.[25]

Wireless broadband plans commonly impose limits on total monthly usage. A customer who exceeds that limit must pay substantial charges. A customer can reduce his or her usage by using wireless devices over a home Wi-Fi network or in Wi-Fi hotspots. But home networks and hotspots depend on the wireline network. In this way, even so-called wireless networks actually depend on the presence of a robust wireline network for backhaul from wireless towers.

Fixed wireless service is not mobile, and it may be on the threshold of becoming a major competitor for voice and broadband. Some wireless broadband providers offer broadband service at a fraction of the going price for wireline service or for wireless mobile service.

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[17] FCC Wireline Competition Bureau, Numbering Resource Utilization in the United States, NRUF Data as of June 30, 2010, released April 2013, Table 1.

[18] Blumberg and Luke, *Wireless Substitution: Semiannual Estimates from the NHIS ER Program*, available at http://www.cdc.gov/nchs/ppt/nchs2012/LI-20_blumberg.pdf, accessed May 31, 2013.

[19] A. Smith, *The Best (and Worst) of Mobile Connectivity*, Pew Internet and American Life Project, *http://pewinternet.org/Reports/2012/Best-Worst-Mobile.aspx*, accessed May 29, 2013.

[20] This compares to only 9% of adults aged 65 or over who were wireless-only. Homeownership also mattered, with 56% of adult renters being wireless-only, but only 21% of adult homeowners. Poorer households, black households, and Hispanic households were also more likely to be wireless-only. *Id.*

[21] 56% of renters rely only on wireless phones, versus 21% of homeowners. *Id.*

[22] 56% of adults in poverty rely only on wireless phones, versus 29% of higher income adults. *Id.*

[23] 36% of adults in the South rely only on wireless phones, versus 21% in the Northeast. *Id.*

[24] 81% of adults aged 25-34 own smartphones.

[25] 78% of persons living in households earning $75,000 or more own smartphones.

Availability is spotty in rural areas, but that could change as the FCC allocates more spectrum for this kind of service.

3. Satellites

A household not served by fixed or wireless broadband can usually get satellite broadband service. Satellite service has been improving in recent years. In 2011, the satellite industry launched a new generation of satellites offering performance as much as 100 times superior to the previous generation, leading to the entry of new satellite-based broadband providers.[26]

4. Broadband

In 1995, only one in ten adults in the U.S. was using the Internet, at any speed.[27] Most customers who did use it had modems that moved data slowly over analog voice telephone lines.[28] Some data services at the time, such as Prodigy and America Online, offered access to a "walled garden" of data but no direct access to the public Internet as we now know it. Broadband was an expensive service used by universities, defense facilities, and a few industrial parks. Internet software was cumbersome and lacked graphical interfaces.[29]

Since then, broadband subscribership has increased spectacularly. By mid-2011, 78% of U.S. adults used the Internet.[30] Moreover, broadband has almost entirely replaced dial-up as the preferred means to obtain Internet access. In mid-2011, 62% of adults in the U.S. accessed the Internet through broadband, and only 3% used dial-up.[31] By the end of 2011 the U.S. had 99 million fixed broadband connections and another 142 million wireless broadband connections.[32]

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[26] See FCC, *2013 Measuring Broadband America February Report: A Report on Consumer Wireline Broadband Performance in the U.S.*, p. 4.

[27] See http://pewinternet.org/Trend-Data/Internet-Adoption.aspx, accessed May 22, 2013.

[28] In 1994, some portions of the Vermont network could not even support modem speeds of 14 kilobits per second, which is less than 1% of the speeds the FCC currently requires for funding.

[29] For example, an early Internet program was Gopher. This text-based program allowed users to access data files at remote locations such as universities but had no graphical interface.

[30] K. Zickuhr and A. Smith, *Internet Adoption over Time,* Pew Internet Report, available at http://www.pewinternet.org/Reports/2012/Digital-differences/Main-Report.aspx, accessed May 22, 2013.

[31] *Id.*

[32] FCC, *Internet Access Services: Status as of December 31, 2011* (2013 Internet Access Report) Table 1.

Internet usage is strongly correlated with household income, age, and education. Low-income people use the Internet less frequently.[33] Younger people and more educated people use the Internet more frequently.[34] Broadband is widely distributed throughout the country, except in some rural areas. The FCC does not directly report local data on the availability of broadband by household.[35] Recently, the FCC did report that 99% of census tracts in the country have residential broadband available somewhere in that census tract.[36]

Vermont is fortunate in having very detailed information about broadband deployments in its rural areas. The Vermont Department of Public Service maintains up-to-date and detailed information on locations within Vermont that do not have broadband available.

5. Voice over Internet Protocol

Voice over Internet Protocol (VoIP) is a new service that has created a fundamental challenge for telephone companies. VoIP uses IP packet routing and can run over either the public Internet or a private IP network. All a customer needs is a computer and a broadband connection. VoIP replicates nearly all the features of traditional voice service, and it is inexpensive because it replaces the traditional telephone switch with less costly computers, even smartphones, owned by the customer.

VoIP calls can be fully interconnected with traditional switched public network lines. Companies such as Vonage have offered this kind of voice service for years in Vermont and elsewhere to customers who provide their own broadband connections. ILECs, whose chief product is voice service, have begun to offer "naked DSL" to customers who do not subscribe to their voice service, thereby enabling their customers to subscribe to third-party VoIP services.

In 1994, the concept of telephone service included not only the hardware and software that defined the user's experience but also the cables and wires that brought that service to the customer's residence. The new VoIP technology demonstrates that voice service can be offered

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[33] 97% of high-income homes use the Internet, but only 62% of homes with incomes below $30,000 per year. K. Zickuhr and A. Smith, *Internet Adoption over Time,* Pew Internet Report, available at http://www.pewinternet.org/Reports/2012/Digital-differences/Main-Report.aspx, accessed May 22, 2013.

[34] 95% of adults under 30 use the Internet, but only 41% of adults age 65 or more. 95% of college graduates use the Internet, but only 43% of adults without a high school diploma. *Id.*

[35] The FCC allows reporting entities to aggregate subscriber connections by census block, thus obscuring differences within census blocks.

[36] *2013 Internet Access Report,* Table 5(a). For this purpose, the FCC counted broadband only if it provides at least 3 Mbps downstream and 768 kbps upstream. Because rural census blocks are sometimes quite large, this statistic is not particularly useful. A single customer in a large rural census block can cause the FCC to consider that census block fully covered by broadband. This effect overstates the availability of broadband.

by a provider that owns no distribution facilities. These kinds of VoIP services are called "nomadic."

VoIP services offered by cable companies and telephone companies generally use privately managed IP networks and are non-nomadic. Therefore, for cable and telephone companies, VoIP is merely a different technology to offer telecommunications services. As was previously true of switched telephone service, the VoIP service offered today by cable companies is vertically integrated, with the company controlling both the application level of the service and the network itself.

VoIP has become increasingly popular. By the end of 2011, there were almost 37 million VoIP lines in the U.S.[37] This is about one-fourth of the number of voice lines in the U.S.[38] Among the VoIP lines, about 70% are classified as non-nomadic, non-ILEC lines, which means in most cases that they are provided by cable companies.[39]

6. IP Networks

VoIP foreshadows the fundamental structural and economic changes that IP technology is likely to cause in telecommunications networks. First, as a matter of communications volume, data usage has vastly overwhelmed voice usage. Counting PSTN voice and Internet voice together, voice probably makes up no more than 5% of the total communications traffic today.[40] At the other extreme, real-time entertainment has the greatest usage. Netflix alone accounts for one-third of IP network traffic during peak periods.[41] These statistics mean that telecommunications network usage has grown far beyond the bounds of all traditional legal concepts surrounding telephone services. Vermont networks are being used for far wider purposes than the 1997 Legislature envisioned.

IP networks are layered. The lower layers operate network hardware and all the timing and checking information needed to keep the network running smoothly. The highest layer is the application (or app) that the user sees. The IP layer sits between the applications and the hardware, and it mediates requests and information flows from both ends.

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[37] FCC, *Local Telephone Competition: Status as of December 31, 2011* (2013), Figures 2, 5.

[38] The FCC reported 143 million VoIP and switched (non-VoIP) lines at the end of 2011. *Id., Figure 2.*

[39] The FCC reported 26.2 million non-nomadic non-ILEC lines. *Id.*, Figure 5.

[40] A recent survey of network usage shows that in North America's fixed-access networks, only about 3% of the traffic is telecommunications. Voice, which is a component of telecommunications, is an even smaller component. Sandvine, *Global Internet Phenomena Report, 1H 2013,* p.5, available at http://www.sandvine.com/downloads/documents/Phenomena_1H_2013/Sandvine_Global_Internet_Phenomena_Report_1H_2013.pdf.

[41] *Id.* Web browsing in total is a comparatively minor 12% of network usage.

Layering allows applications to operate somewhat independently of network facilities. Sitting on top of the IP layer, an application can interact with a variety of networks without knowing about the details of the underlying hardware. Sitting underneath the IP layer, network hardware can be agnostic as to which application is running. Generally, an IP network does not know or care whose packet it is routing or who might have developed the app that generated that packet. The old Bell system granted development rights only to sanctioned parties.[42] The new architecture is a dramatic change that has fostered the development of thousands of applications.

Because IP allows network applications and facilities to operate independently, each has its own costs and its own revenues. For example, Google can generate revenue without assuming any network maintenance responsibility. At the facilities end, FairPoint can generate DSL revenue without concerning itself with which applications its customers are using. Unfortunately, the opportunities are not symmetrical. Particularly in rural states like Vermont, networks typically generate most of the costs, while applications seem to have the greater opportunity to generate the revenues. This is a fundamental change from classical vertically integrated telephone networks, in which both network facilities and application development were supported by common revenues.

While the network and application layers are operationally independent, over the longer run they are economically intertwined and could become more so. Generally, application developers like Google depend on the physical network to provide ever-increasing data speeds and to provide ever-improving service quality. For that reason, network operators have an interest in meeting the needs of application developers for speed and quality control. Network operators have responded to these demands by providing higher-quality services to particular apps or users. It is not clear yet whether network providers will be allowed to charge the application providers based on these quality-of-service differences. If they can, a part of the application providers' revenue will begin to flow to the network providers.[43]

The FCC has ruled that Internet data transmission is an information service and not a telecommunications service. This has raised a host of questions, including whether Internet data transmission services can be made a part of the base that contributes to universal service.

These economic changes and the current regulatory structure increase the challenge for Vermont policymakers as they seek ways to construct and maintain a ubiquitous high-quality network. IP networks tend to be supported by their end users exclusively, and there are few or no opportunities for contributions from applications developers and from the subscribers of services like Netflix.

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[42] Not all networks operate with this kind of independence. Managed IP networks give network operators the ability to create preferences among network uses and even among users. These managed networks are becoming increasingly popular as newer applications require service quality controls, such as limits to latency delays.

[43] The FCC's authority to regulate the relationship between the network and application providers is being litigated in *Verizon v. FCC*, Case No. 11-1335, at the U.S. Court of Appeals for the D.C. circuit.

C. Legal and Market Changes

During the intervening two decades since 1994, the legal environment in which incumbent telephone companies operate has also changed noticeably. This section summarizes those legal changes, with emphasis on how they affect the design of a modern state USF program.

1. Wireline Competition

The 1994 Vermont Legislature understood that competition was likely coming to the local exchange industry. That expectation was strengthened by the federal Telecommunications Act of 1996, which prevents states from establishing "barriers to entry" in the local exchange telecommunications market.[44] Thus, in the 1990s, Vermont's legislators and regulators alike expected that opening of local exchange markets to competition would create a bloom of competitive local exchange providers (CLECs).

The scope of the change proved considerably more modest. Today, traditional CLECs own fewer network facilities and serve far fewer customers than originally foreseen.[45] Moreover, traditional CLECs generally concentrate on business customers,[46] and they often limit service to densely populated areas near existing central offices or to large anchor customers such as universities or office parks. For these reasons, traditional CLECs have little bearing on universal service policy in high-cost areas.

Cable television companies are another kind of CLEC. Cable CLECs began offering voice service in Vermont in approximately 2008. Since then, they have made substantial inroads into local exchange markets, both in Vermont and nationally. As noted above, cable CLECs had approximately 33 million access lines throughout the U.S. by the end of 2011.[47]

Cable CLEC distribution networks are not as ubiquitous as traditional telephone networks. In Vermont and elsewhere, cable CLECs are not required to serve every location in a township or telephone exchange area. Instead, cable providers are allowed to limit their required

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[44] 47 U.S.C. § 253.

[45] Traditional CLECs today provide service using some facilities that they own, but they frequently operate using mainly rented ILEC facilities. Those rentals decreased after the FCC narrowed CLECs' rights to use ILEC networks approximately 10 years ago.

[46] Competitors also found it difficult to serve the residential market because leases of incumbent network elements have changed from regulated unbundled network element rates to commercial agreement rates.

[47] FCC, *Local Telephone Competition: Status as of December 31, 2011* (2013), Figure 6 (Non-ILEC cable modem-based connections = 23.9 million).

network expansions to more densely populated portions of their own franchise areas.[48] This means cable CLECs on average have shorter cable runs than the ILECs serving the same areas. It also creates a cost advantage over the local ILEC.[49]

Cable CLECs have other advantages over ILECs and traditional CLECs:

- Cable companies have existing digital delivery platforms for television and have high data transmission rates. This reduces the cable CLEC's incremental cost of providing voice and broadband service over existing television networks.[50]
- Cable companies have established relationships with many potential voice and Internet customers.
- Some cable CLECs can acquire video content at lower cost than non-cable CLECs and ILECs. This economic advantage can arise from greater economies of scale but also from common ownership or strategic alliances between cable CLECs and content providers.

2. Bundling

Customers today are buying different kinds of products than in 1994. This complicates both how Vermont should best collect VUSF contributions from carriers and also how best to define the service that is supported.

In 1994, nearly everyone in Vermont subscribed to basic telephone service at home. These customers paid small or no charges for each call with a relatively small local calling area. Calls to more distant locations were toll calls (long distance), were often provided by a different carrier, and usually had high per-minute rates. The current VUSF statute reflects this historical distinction and excludes toll service from the "basic telecommunications service" that the VUSF statute aims to protect.[51]

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[48] Under Public Service Board rule 8.313(C), a cable company must file a tariff describing its policy on extending lines into unserved areas. Under certain circumstances, that rule requires cable companies to perform line expansions without requiring contributions in aid of construction. The circumstances considered include the number of verified subscribers per mile.

[49] That advantage can possibly be offset by other factors, such as the electric power needed to run a cable distribution network.

[50] Incremental costs consist mostly of replacing one-way amplifiers, adding some fiber runs, and buying low-cost soft switches.

[51] The Vermont USF statute defines basic telecommunications service as: (A) switched voice grade interactive telecommunications service permitting origination and termination of calls; (B) the ability to transmit network switching instructions through tones generated by customer-owned equipment; (C) the ability to transmit and receive the customer's computer-generated digital data, either by digital or analog

Today, most customers buy a voice bundle that includes local calling and at least some toll calling. A common package includes unlimited toll within the United States, and often Canada. Some cable companies and VoIP providers today sell only this kind of bundled voice service.[52]

The popularity of bundles complicates the task of defining the service that the state wants to sustain. One option is to support only the costs for unbundled local exchange service, without long-distance or broadband.[53] If the great majority of customers buy more costly services, however, it is difficult to argue that such a definition matches current needs. Further, the cost of such a limited network would not be strongly tied to the cost of telecommunications networks that must actually provide a range of services.

3. Wholesale Sales

In the current Vermont statute, there is a clear boundary between "carriers" and "customers." Customers are those who buy at retail. They must pay the VUSF surcharge in addition to what they otherwise pay. Carriers, on the other hand, are exempt from VUSF surcharges, but they must collect and remit VUSF charges paid by their customers.

Today, a range of new entities occupy a middle ground between carriers and customers. The Internet is a particularly thorny area, because the "providers" of Internet service insistently argue they are not subject to traditional common carriage regulation and therefore are not "carriers." In addition, a number of retail outlets sell telecommunications-related items like prepaid toll usage cards, prepaid cell phone cards, and even wireless local exchange service.

This blurring of the traditional carrier-customer boundary complicates universal service policy. A modern universal service mechanism must clearly categorize market participants and must clearly assign the duties of each group.

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transmission, reliably and at common transmission rates, using customer-owned equipment; (D) the ability to communicate quickly and effectively with emergency response personnel; and (E) telecommunications relay service, as authorized under section 218a of this title. 30 V.S.A. § 7501(b)(1). This definition does not mention toll service. In contrast, 30 V.S.A. § 7501(5)(A)(ii), which defines the obligations to contribute to the fund, does include toll service.

[52] See, e.g., http://wwwb.comcast.com/corporate/shop/productoverview.aspx, accessed May 21, 2013.

[53] Wyoming's USF program bases support on the difference between a carrier's rate for "essential" service and the statewide average rate. "Essential" service rates in Wyoming are local exchange rates paid by customers who do not buy bundles.

D. Funding Changes

During the two decades since 1994, the funding for incumbent telephone companies has changed considerably. This section summarizes those funding changes, with emphasis on how they affect the design of a modern state USF program.

In 1994, a large part of the revenue of Vermont's rural ILEC came from intercarrier payments, notably access payments relating to toll traffic.[54] Interexchange carriers like AT&T and MCI paid money to Vermont ILECs in order to have the right to originate and terminate toll calls on those ILECs' lines. Calls within Vermont were subject to access charges[55] at rates set by the Vermont PSB. Interstate and international calls also generated access charges, but at rates set by the FCC. These access charges are declining, as we discussed in Volume I and Volume II of this report.

Another large part of the revenue of Vermont's rural ILEC in 1994 came from USF support payments supervised by the FCC. One, the High Cost Loop (HCL) program, provided considerable support for nearly all of Vermont's smaller companies. New England Telephone, the predecessor of FairPoint, also received some HCL support. Nearly all of these federally defined and supported systems have changed fundamentally since 1994, often in ways that have reduced support to Vermont ILECs.

- HCL has been severely limited by budgetary caps. The effect has been to concentrate an ever-decreasing amount of total support on a few very high-cost companies.[56] More recently, the FCC imposed support limits on individual companies with spending higher than an FCC formula would predict.[57]

- In 2001, the FCC created Interstate Common Line Support (ICLS). In 2011, Vermont companies received annualized ICLS support of $6.5 million, but the FCC subsequently placed constraints on that program. The FCC also proposed a ratemaking change in 2013 that could further constrain ICLS funding.[58]

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[54] We take no position on whether access charges are payments for services or support payments.

[55] For example, if an AT&T customer in Chicago calls a Waitsfield customer in Warren, Waitsfield would typically receive a per-minute access charge payment from AT&T. Those access charges would compensate Waitsfield for the use of its switch and local network.

[56] For example, Waitsfield received $1.7 million in HCL support in 2001, $0.9 million in 2005, and zero in 2010.

[57] This new cap affects only Topsham Telephone in Vermont.

[58] The proposal is to reduce the weighted average cost of capital used by the FCC in calculating the interstate revenue requirement of rate-of-return companies. This could reduce ICLS payments.

- In its 2011 *USF/ICC Transformation Order,*[59] the FCC mandated reduction (and in some cases elimination) of access charges, both interstate and intrastate. This mandate is currently on appeal in the federal courts. The financial effects of the *USF/ICC Transformation Order* were estimated in Volume I of this report.

- Smaller companies have received public grant and loan financing for network expansions from the Rural Utilities Service of the U.S. Department of Agriculture. Availability of these loans and grants has varied over the years.

New kinds of federal and state funding were also introduced after 1994 to support broadband deployment. These new programs generally offer direct grants for capital spending.

- In February of 2012, the Public Service Board PSB authorized Fairpoint to spend $6.6M to extend broadband service throughout target communities containing over 3,000 locations. The money would otherwise have been refunded to customers as retail service quality penalties.[60]

- In August of 2010, the Rural Utilities Service awarded Vermont Telephone Company (VTel) a broadband stimulus grant of more than $81 million and a $35 million government-backed loan. VTel said the federal funds would enable VTel to build a fourth-generation wireless technology "Internet system to nearly all of Vermont's unserved homes, businesses and anchor institutions; a one gigabit fiber network to VTel's existing customers; and a community visit program aimed at helping Vermonters identify ways broadband access can improve social and economic opportunities."[61]

- In December 2012, the FCC awarded $2.1 million Phase I Mobility Funding to VTel Wireless for additional wireless deployment covering 941 road miles in Vermont.[62]

- The Vermont Telecommunications Authority (VTA) has made multiple capital grants to broadband providers. These appropriated state funds are intended to

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[59] *See Connect America Fund*, WC Docket No. 10-90, Report and Order and Further Notice of Proposed Rulemaking, FCC 11-161, 26 FCC Rcd 17663 (Nov. 18, 2011) (*USF/ICC Transformation Order),* Petitions for Review pending.

[60] PSB Order in Dockets 7725-7726, http://psb.vermont.gov/sites/psb/files/orders/2012/2012-2/7725-7726%20FnlOrder.pdf

[61] Congressman Welch press release of August 4, 2010, available at http://www.welch.house.gov/index.php?option=com_content&task=view&id=1121&Itemid=.

[62] The FCC did not make any similar grants in New Hampshire or New York. Maine received some grants, but only for its extreme northeast corner.

create incentives for broadband providers to reach the most rural locations.[63] Notably in 2012 the VTA awarded:

- VTel Wireless $1.3 million to expand broadband services to 306 locations in 19 communities.[64]
- FairPoint $0.33 million to expand broadband to 44 locations in 3 communities.[65]
- Comcast $0.25 million for areas of Shaftsbury, Pownal, and Braintree.[66]
- Topsham Telephone $0.38 million for areas of Topsham and Bradford.[67]

A key idea behind traditional rate regulation is that ILECs should raise their capital privately, and that rates should provide sufficient revenues to allow carriers to earn a return on their net investment. This "cost of capital" model was used in both utility rate regulation and classical universal service support programs,[68] and it historically generated enough private capital to build the existing ILEC network. The newer support mechanisms depart from this model and use public funds to provide direct capital grants.

E. Regulatory Changes

In the two decades since 1994, the regulatory environment in which incumbent telephone companies operate has also changed dramatically. This section summarizes those regulatory changes, with emphasis on how they affect the design of a modern state USF program.

1. Uncertainties in Federal Law

The Telecommunications Act of 1996 created a distinction between "telecommunications services" and "information services." The FCC has interpreted this statutory distinction in ways that have created legal uncertainty for state USF programs.

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[63] Vermont TelecommunicationsAuthority press release, September 4, 2012, available at http://www.telecomvt.org/node/167, accessed May 30, 2013.

[64] Vermont Telecommunications Authority press release, September 4, 2012, available at http://www.telecomvt.org/node/167, accessed May 30, 2013.

[65] Vermont Telecommunications Authority press release, September 4, 2012, http://www.telecomvt.org/node/166, accessed May 30, 2013.

[66] Vermont Telecommunications Authority press releases, June 27, 2012, available at http://www.telecomvt.org/node/154, accessed May 30, 2013.

[67] Vermont Telecommunications Authority press releases, June 27, 2012, available at http://www.telecomvt.org/node/155, accessed May 30, 2013.

[68] This model served as the basis for early USF programs such as HCL and until recently for both access rates and ICLS.

Of primary importance is the FCC's treatment of broadband. The FCC has ruled that broadband Internet connectivity is (at least for purposes of federal law) an "information service" rather than a "telecommunications service." In telecommunications parlance, the "triple play" is a bundle of voice, Internet, and video. The FCC rulings have created uncertainty about what parts of a triple-play package can be subjected to a state's USF surcharge. Although several states now use their USF funds to support broadband facilities, federal law creates doubt about whether states have authority to impose USF surcharges on broadband services.[69]

The FCC has also repeatedly declined to say whether VoIP is an information service or a telecommunications service.[70] This state of limbo has complicated USF contribution issues. The FCC has allowed states to impose VUSF surcharges on a portion of VoIP revenues.[71] The FCC has not said, however, whether a state can impose a surcharge on interstate or international VoIP revenues.

Since the early 1990s, states have been preempted from regulating the rates of mobile wireless carriers.[72] Similarly, states do not have authority to regulate the rates or terms of service of broadband offerings by cable television providers[73] or fixed wireless broadband providers.

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[69] See *Nat'l. Cable Telecom. Ass'n. v. Brand X Internet Services,* 125 S.Ct. 2688 (2005) (cable modem service is information service); FCC, *Appropriate Framework for Broadband Access to the Internet over Wireline Facilities*, CC Docket No. 02-33, Report and Order and Notice of Proposed Rulemaking, FCC 05-150 (2005) (DSL is an information service). Because many state laws apply a USF surcharge or tax only to retail telecommunications services, those federal rulings may prohibit states from imposing USF surcharges on broadband revenue. Also, most states impose USF surcharges only on the intrastate portion of telecommunications services. Vermont imposes the USF surcharge on intrastate, interstate, and international revenues.

[70] Even though the FCC didn't clarify the nature of the service, it did assert that states are preempted from imposing rate regulation on the providers. The FCC reasoned that it was not possible to separate the interstate and intrastate aspects of the VoIP service offered by Vonage. *Vonage Holdings Corporation Petition for Declaratory Ruling Concerning an Order of the Minnesota Public Utilities Commission*, WC Docket No. 03-211, Memorandum Opinion and Order, 19 FCC Rcd. 22404, 22423, para. 11 (2004) *aff'd, Minn. Pub. Utils. Comm'n v. FCC*, 483 F.3d 570 (8th Cir. 2007).

[71] The FCC's published safe harbor allows states to impose a surcharge of 35.1% on VoIP revenues, the portion that is presumed intrastate. However, interconnected VoIP providers typically report only approximately 22% of their traffic is interstate or international. FCC Wireline Competition Bureau, *Telecommunications Industry Revenues: 2009*, released May 2011, Table 6: Revenues from Telecommunications and Interconnected VoIP Service Provided to End Users: 2009. All traffic is either international, interstate, or intrastate. Therefore, where a carrier reports 22% of its revenue as interstate or international, a state could conceivably impose a surcharge of 78% on that carrier's VoIP traffic.

[72] 47 U.S.C. § 332(c)(3)(A).

[73] E.g., *Nat'l. Cable Telecom. Ass'n. v. Brand X Internet Services,* 125 S.Ct. 2688 (2005).

2. State Regulatory Changes

Since the 1990s, state regulation of telecommunications services has moved strongly toward deregulation. All FairPoint rates except basic local exchange (dial tone) services are deregulated, and those rates for basic service have not been adjusted for many years.[74] For all ILECs other than FairPoint, voice rates have been essentially deregulated.[75]

3. Nonregulated Subsidiaries

The 1990s was a time of great optimism that toll markets would become competitive, and several Vermont ILECs created subsidiaries to sell toll services.[76] In the intervening years, most customers have decided to eliminate a separate monthly toll bill by purchasing toll services from the same entity they use for local exchange. As a result, several Vermont ILECs are selling bundles of services that generate revenues for a toll subsidiary. But the practice of dividing costs and revenues further complicates the state's task of calculating a suitable VUSF payment.

Some companies also have separate broadband subsidiaries.[77] These broadband companies get revenue when a customer buys a double-play service that includes voice and broadband. Allocating costs fairly to a broadband subsidiary can be a complex task.

To calculate a VUSF support amount properly, the state must allocate the costs and revenues of each supported carrier's toll subsidiaries and broadband subsidiaries, if any.[78]

4. FCC's 2011 Regulatory Changes

The 2012 legislation that chartered this study requires that this report:

> Examine the actions, if any, of the Federal Communications Commission (FCC) in revising its universal service fund, and the need, if any, for additional action in Vermont. In particular, the study shall examine the impact on Vermont services caused by the FCC's report and order released November 18, 2011, which, among other things, expands the federal universal service fund to include broadband deployment in unserved areas.

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[74] Many states have price-cap plans for larger carriers such as FairPoint.

[75] Rates for these companies were deregulated five years after the companies declared themselves to be "small eligible telecommunications carriers." 30 V.S.A. § 227d. By 2013, all Vermont's small carriers had passed through this window and are no longer subject to any routine process that restricts their legal ability to raise rates on intrastate voice services.

[76] VTel and the three TDS companies do not sell toll service through a subsidiary.

[77] VTel and the three TDS companies do not sell broadband through a subsidiary.

[78] In some ways, such an "all-in" approach to costs can be simpler than attempting to fairly allocate costs between regulated and unregulated subsidiaries.

> Further, the study shall consider the potential impact of various legal challenges to the FCC action on the federal universal service fund.

The likely effects of the FCC were considered in detail in Volume I of this report. In summary, the FCC's order altered several traditional revenue streams of Vermont's ILECs and created substantial uncertainty about whether and in what amounts the new mechanisms would replace those revenues.

Considering all Vermont incumbents together, we estimated in Volume I that annual affected revenue streams will decline over the forecast period by $11.6 million, or 38%. However, we also found that those predicted losses are relatively minor in the context of all regulated operations. This means that the revenue losses from the *USF/ICC Transformation Order*, while substantial, are a minor portion of the total regulated revenues of the incumbent carriers, which are currently at $209 million.

We estimated in Volume I that the two FairPoint Vermont operating companies are likely to suffer substantial support losses, be required to redirect general support to make additional capital expenditures, or both. Affected revenues are expected to decline over the forecast period by $8.6 million, with larger losses in subsequent years. Affected revenues are only a small part of FairPoint's overall annual regulated revenue of $161 million. Trends in other revenue streams will likely have more influence on FairPoint's financial viability. Future line counts and special access revenues are particularly important parameters that create considerable uncertainty in future estimates.

As to the smaller rate-of-return companies in Vermont, we estimate their annual affected revenues will decline by $2.9 million, or 17%, over the forecast period. Placing this in context, these companies currently have annual regulated revenues of $48 million. This means that the $2.9 million expected revenue losses from the *USF/ICC Transformation Order*, while substantial in absolute terms, will be a minor portion of the total regulated revenues of the incumbent rate-of-return carriers.

The details differ substantially among the rate-of-return companies. Over the forecast period, we estimate affected revenue reductions of at least 15% for VTEL and Waitsfield and at least 25% for Franklin, Shoreham, and Topsham.

F. The Rural Divide

In universal service parlance, the "rural divide" refers to the greater availability and quality of telecommunications services in urban areas. Over the years, the FCC and many state governments have acknowledged this rural divide many times.

As to voice services, there seems to be no meaningful rural divide in Vermont. According to FCC data, Vermont has a very high rate of telephone penetration, 98.2%.[79] Vermont telephone companies have had roughly a century to build their networks, and today all or nearly all residential locations in Vermont can get landline voice service from the local ILEC.[80]

A rural divide does exist nationally for 3G and 4G wireless data service. Almost three in every five urban and suburban Americans own smartphones, but only two in five rural Americans do.[81] At least a major portion of this usage difference is undoubtedly due to the existence of rural areas that have no wireless signal or cell towers that do not support the latest 4G technologies.

Broadband is where the rural divide is most obvious today. In many urban areas, broadband services are even more widely available and are now nearly universal. Some urban areas are even receiving superfast speeds at hundreds of megabits per second. In Kansas City, Google is deploying gigabit (1,000 Mbps) services, and one industry source reports that over 40 U.S. communities have gigabit FTTH service.[82] In Vermont, Burlington Telephone has built FTTH throughout much of that city.

Nationwide, rural communities have significantly less broadband than urban areas. Figure 1F1 shows National Telecommunications and Information Agency (NTIA) data on how many customers had broadband available at specific speeds in 2012.

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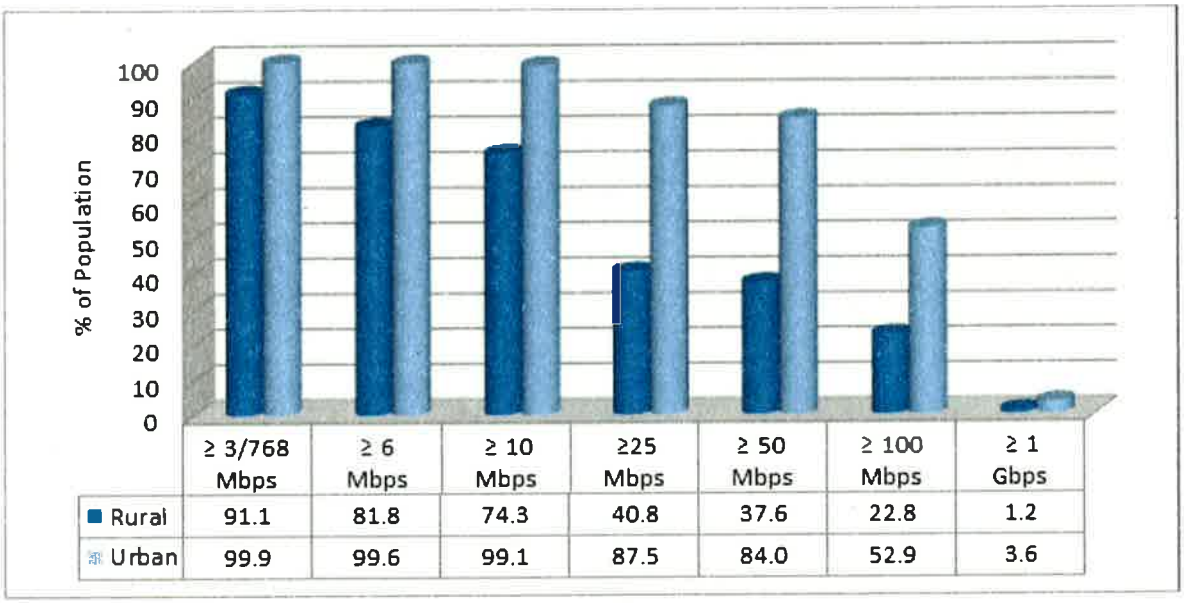
[79] That national average is 97.4%. FCC, CC Docket No. 96-45. *Universal Service Monitoring Report for 2012*, Table 3.6.

[80] The few locations that cannot get that service at a minimal connection charge are generally on newly settled roads without utility lines. Those locations can get service if they pay approved line extension costs.

[81] Pew Internet and American Life Project, *Smartphone Ownership – 2013 Update,* http://pewinternet.org/~/media//Files/Reports/2013/PIP_Smartphone_adoption_2013.pdf, accessed June 10, 2013.

[82] *Telecompetitor* (e-mail newsletter), June 18, 2013.



	≥ 3/768 Mbps	≥ 6 Mbps	≥ 10 Mbps	≥25 Mbps	≥ 50 Mbps	≥ 100 Mbps	≥ 1 Gbps
Rural	91.1	81.8	74.3	40.8	37.6	22.8	1.2
Urban	99.9	99.6	99.1	87.5	84.0	52.9	3.6

Figure 1F1. Broadband Availability by Urban and Rural (June 2012)[83]

NTIA also maintains that the likelihood of broadband coverage increases with population density and with proximity to a metropolitan statistical area (MSA).[84] If NTIA is correct, broadband coverage would be expected to be good in Vermont neighborhoods that are urban or suburban or that are near Burlington. NTIA online maps confirm this theory.

Fiber-to-the customer is the highest-capacity broadband service of all. Figure 1F2 displays NTIA's estimate of fiber-to-the-customer availability for the Burlington and Montpelier areas in 2012.

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[83] National Telecommunications Information Agency, *U.S. Broadband Availability: June 2010 – June 2012,* http://www.ntia.doc.gov/files/ntia/publications/usbb_avail_report_05102013.pdf, accessed October 7, 2013 p. 10. NTIA also has an online map showing availability of broadband by technology. See http://www.broadbandmap.gov/technology.

[84] National Telecommunications Information Agency, *Broadband Availability beyond the Rural/Urban Divide,* Broadband Brief No. 2, May 2013, http://www.ntia.doc.gov/files/ntia/publications/broadband_availability_rural_urban_june_2011_final.pdf, accessed October 7, 2013, p. 1.

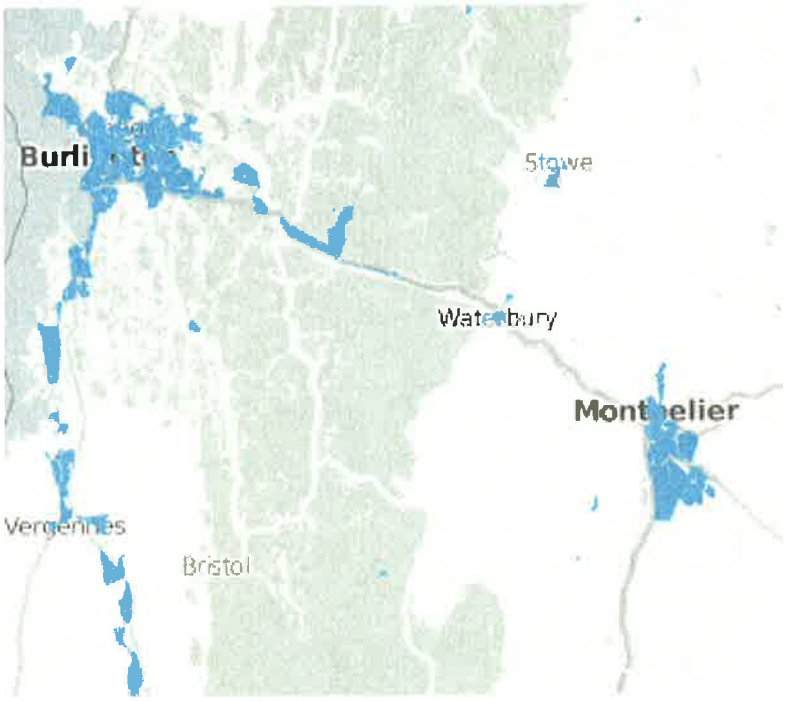

Figure 1F2. NTIA Estimate of Fiber-to-the-End-User Service in Central Vermont (2012)

Cable modem service is the next fastest terrestrial service (after FTTH). Figure 1F3 shows NTIA's estimate of cable modem availability for approximately the same area.

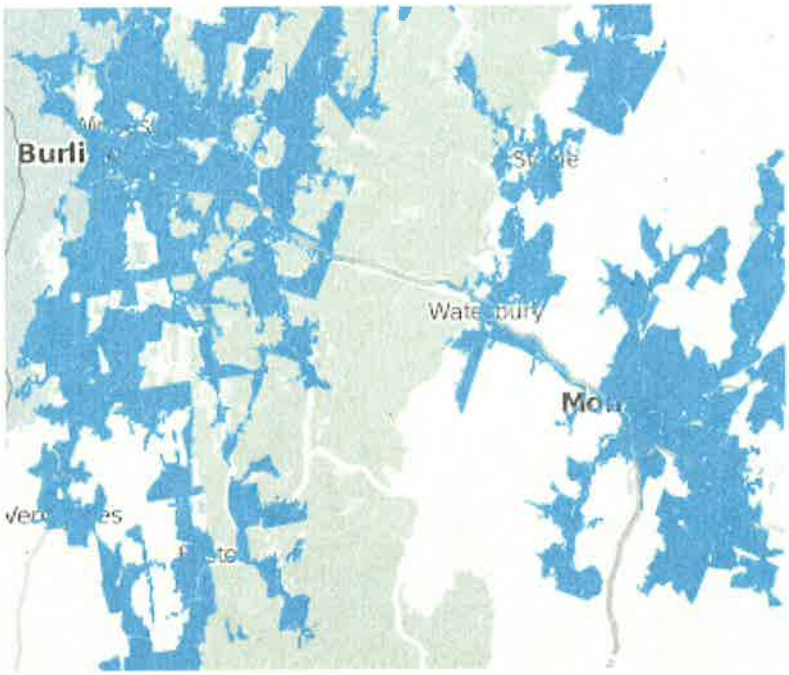

Figure 1F3. NTIA Estimate of Cable Modem Service in Central Vermont (2012)

Figure 1F3 shows that cable modem service goes farther out into the countryside than the fiber, but it still leaves a great deal of the landscape unserved.

In sum, Vermont resembles the rest of the country with respect to broadband deployment. Some areas have very fast broadband service, but those areas tend to be urbanized. Vermont is unusual in that several areas served by smaller ILECs also offer FTTH. Also, Vermont has made a financial commitment to support fixed wireless broadband in rural areas, although no statewide network is yet operating.

G. The Current Need for High-Cost Universal Service Support

The Vermont Legislature will decide whether the Vermont USF will provide high-cost support. We recommend that this legislative decision be informed by history, by current financial conditions, by legal constraints, and by the consequences of ILEC failure. Each of these topics is discussed below.

1. Historical Background

The 1994 Legislature indicated an interest in the topic, enough to hold open a place for a high-cost authorization statute and to authorize a study. The original impetus for the Vermont Universal Service Fund was twofold. Most urgently, the state needed a way to finance its new E-911 program. Also, it appeared that local exchange competition was coming and would reduce the ability of ILECs to continue charging above-cost rates in low-cost areas to support below-cost rates in high-cost areas. This second purpose led to the naming of the fund as the "Vermont Universal Service Fund."

Local exchange competition actually developed more slowly and in more geographically restricted ways than was originally foreseen in 1994. Most hopes originally rested with wireline CLECs, but they proved to be primarily interested in the business market, and even then only in relatively low-cost areas. When competition did arrive over the last decade, it took unexpected forms. We described in Section I above the changes in technologies, markets, and regulation since 1994, including the new competition from wireless and cable networks.

2. Financial Conditions

Competition has been largely responsible for the financial changes to the ILEC industry, although federal regulatory policies have also been important. In Volume II of this study, we explained that most Vermont ILECs suffered substantial line losses in 2011 and are expected to do so again in 2013.

At the same time, the FCC appears to be retrenching on support for universal service and unwilling to provide sufficient support for voice services. This is likely to leave many high-cost areas either without support or with support that is not sufficient to maintain the financial

viability of the carrier providing the service. Using traditional support assumptions[85] and the FCC's latest cost model,[86] we estimate that a sufficient program of federal support would require annual federal expenditures of $15 billion.[87] The FCC has indicated that its high-cost budget is only $4.5 billion.

To reduce the demand for federal funds, the FCC appears to be adopting a triage model for universal service support. First, the FCC seems likely to eliminate federal support to areas with relatively low costs. This measure greatly reduces the demand for support, down to about $9 billion per year.[88] Some carriers have suggested a high-end cap that would eliminate support to very high-cost areas of the nation.[89] In our opinion, even if the FCC truncates both ends of the cost spectrum, its budget allocations appear insufficient.[90]

As a result of competition and regulatory changes, we estimated in Volume II that Vermont ILECs, on an all-in basis, face projected operating losses of about $40 million in 2013. We found little reason to believe this situation will improve in the coming years.

If events match our estimates of operating losses, the future of telecommunications in Vermont is likely to be more turbulent than the past. Others have agreed. AT&T, which has the largest landline network in the U.S., reported in 2012 that it had been unable to find an economic solution for deploying broadband in "underperforming" rural regions, even with wireless technologies.[91] Similarly, in 2013 Balhoff and Williams stated that:

> [R]ural investment loan activity for smaller carriers is down sharply in the wake of the new reforms, apparently because the companies are gravely concerned about their ability to repay debt and because the lenders are

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[85] We used the current model benchmark of $28.12 per line per month.

[86] This model is under development at the FCC. The original version of this model was proposed and supplied by the price-cap carriers.

[87] This scenario would distribute $9 billion for price-cap carriers and $6 billion for rate-of-return carriers.

[88] This includes $6 billion for price-cap carriers and $3 billion for rate-of-return carriers

[89] The price-cap carriers proposed setting this high benchmark at a cost of $256 per line per month. Another triage-like measure has been the decision of the FCC to limit support to any carrier at a maximum of $250 per subscriber line per month. This measure, which is being phased in at present, limits but does not eliminate support to very high-cost areas. *USF/ICC Transformation Order*, para. 11.

[90] For example, using the triage method, the price-cap carriers would receive $2.2 B per year. However, the FCC has included only $1.8 billion in its universal service budget for price-cap carriers. To meet its budget, the FCC would either have to reduce the high-cost benchmark cutoff ($256) or raise the low-cost benchmark cutoff ($80).

[91] AT&T fourth-quarter 2011 earnings report to analysts, January 26, 2012, transcript available at http://seekingalpha.com/article/322378-at-t-s-ceo-discusses-q4-2011-results-earnings-call-transcript?part=qanda.

> more cautious in lending due to their judgments about industry fundamentals. . . . Our analysis suggests that service will falter in certain regions or significant incremental costs will have to be borne by customers, unless new sustainable and predictable support revenues are made available.[92]

The Balhoff and Williams report concludes that the states "have a very short fuse" and "cannot wait until the FCC issues subsequent orders."[93]

3. Legal Constraints

The Vermont PSB has statutory authority to allow a utility to abandon service. To do so, the Board must find that abandonment is consistent with the public interest. [94]

Federal law seemingly does not even contemplate the possibility of an ILEC failure. It seems to prohibit ILECs from abandoning areas that do not have service from other carriers. [95]

These laws arguably prevent ILECs from terminating local exchange services. To the contrary, we respectfully submit that economics ultimately would trump any law that purports to require an insolvent company to continue operating. Even the strongest imaginable mandate cannot maintain existing facilities, pay the power bill, and provide customer service. In the face of sustained financial losses, service quality will decline and additional support will be necessary.

ILECs appear to have little opportunity to rely on the Constitution for financial relief. Utility law has long recognized that as economic circumstances change, technologies can become obsolete, and utilities may be forced into dissolution without compensation for their investments. In a landmark 1945 case, the Supreme Court addressed a due process claim by a street railway company in San Francisco. The company had allowed its service to deteriorate and its facilities to become obsolete. The company lost riders, and its past price increases had reduced rather than increased revenues. The Court concluded that the financial integrity of the

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[92] Michael Balhoff and Bradley Williams, *State USF White Paper: New Rural Investment Challenges,* June 2013, pp. 24, 27 (italics added).

[93] *Id.,* p. 31.

[94] See 30 V.S.A. § 231(b) (utility may not abandon or curtail any utility service or abandon all or any part of its facilities "if it would in doing so effect the abandonment, curtailment or impairment of the service, without first obtaining approval of the public service board, after notice and opportunity for hearing, and upon finding by the board that the abandonment or curtailment is consistent with the public interest").

[95] The only language discussing withdrawal from service assumes that another carrier will be available to serve the affected area. 47 U.S.C. § 214(e)(4). Moreover, federal law allows state commissions to mandate that a "common carrier" must serve an unserved area. 47 U.S.C. § 214(e)(3).

company had been "hopelessly undermined." The Court noted that most of its due process "takings" cases had dealt with "utilities which had earning opportunities, and public regulation curtailed earnings otherwise possible." In contrast, the light rail industry in the 1940s was "generally sick" without regard to its regulatory constraints. The Court concluded that the due process clause of the U.S. Constitution does not guarantee the possibility of a profit to a company in such circumstances. Stated another way, the due process clause prevents "governmental destruction" of existing economic values but does not insure against losses "by the operation of economic forces." [96]

4. Effects of Wireline Network Failures

There is little in recent history, in Vermont or elsewhere, to illustrate how a wireline network failure would proceed. Under the best scenario, competition would solve most of the problem. For example, as an ILEC's service becomes less reliable, another local exchange provider could overbuild the service area and gradually win most of the subscribers. This simultaneously makes the ILEC's failure more likely but less painful. The PSB could approve abandonment by the ILEC without facing the prospect that many customers would lose all telecommunications services.

A more worrisome scenario is that the ILEC would, with PSB and FCC permission, withdraw service from geographically limited unprofitable areas. The necessary finding of consistency with the public interest might be possible if the alternative is outright financial failure by the entire ILEC and effective abandonment of a larger service area. The PSB might also assign carrier-of-last-resort responsibility to another provider, such as another ILEC or a fixed wireless service, if one could be found that was willing to serve.[97]

The most alarming scenario is that an unprofitable ILEC would drift heedlessly into financial collapse. The end would come when the ILEC could no longer pay the electric bill or meet its payroll.

Failure by one or more ILECs would have numerous secondary effects:

- Some retail customers in the affected area could have no options for voice, broadband, or both. Even where wireless carriers advertise coverage in such areas, specific locations might have signals that are too weak to be useful.

- Substitute retail services may have different characteristics, such as different reliability during grid power outages or during rain or snowstorms.

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[96] *Market St. Ry. Co. v. Railroad Commission of State of California,* 324 U.S. 548 (1945).

[97] Federal law allows state utility commissions to mandate that a "common carrier" must serve an unserved area. 47 U.S.C. § 214(e)(3). Such a mandate might be unconstitutional, however, if the new service area cannot generate enough revenues to justify the required capital investment.

- Emergency services, including E-911, could be disrupted, or data collections necessary to operate E-911 could be impaired.

- Wi-Fi networks that transmit signals through wireline networks may no longer function. Many businesses offer Wi-Fi as a convenience for their customers. Also, smartphones rely on Wi-Fi to reduce the data burden on cell networks.

- Services of other telecommunications carriers could be disrupted, notably including:

    - Wireless networks that use ILEC special-access or point-to-point circuits for backhaul.

    - CLECs that rely on ILEC unbundled elements.

    - Other utilities that use ILEC utility poles.

5. Conclusion

The deteriorating financial status of Vermont's ILECs, combined with the probability of insufficient FCC support, could greatly disturb the current universal service landscape. In the face of such change, a new high-cost USF program is one option. The alternative is to rely on competitive wireline providers, wireless and satellite technology to fill any gaps that might develop in the ILEC wireline network[98] and to accept the risk that some currently served areas might lose wireline service.

The competitive changes in Vermont markets, combined with recent FCC actions, suggest the need for a careful legislative review and a prompt decision about whether to provide high-cost funding to ILECs. To assist the Legislature in that review, Section II below answers statutory questions posed in the 2012 legislation. Section III then discusses principles and goals that should guide a new support mechanism. Section IV discusses some preliminary policy issues. Section V discusses three possible support mechanisms.

Competitive changes in Vermont markets, combined with recent FCC actions, suggest the need for a careful legislative review and a prompt decision about whether to provide high-cost funding to ILECs.

[98] This option is discussed in Sections IV.C and IV.D below.

II. The Economics of Universal Service

A. Rates and Subscribership

The 2012 law chartering this study requires that this report:

> Estimate the relationship between basic telecommunications service charges and universal service, and the threshold level beyond which universal residential service is likely to be harmed.

The task statement implies a threshold or bright line rate above which universal service is harmed. In some USF high-cost mechanisms, there is such a threshold rate, or benchmark, that is subtracted from cost in the process of calculating support. The theory is that a service price above this benchmark will cause consumers to switch to a competitive carrier or terminate their service altogether. Either kind of response could push a Vermont ILEC into a death spiral in which ever-higher prices repeatedly reduce subscribership and revenues, eventually leading to a business failure and likely bankruptcy.

The price elasticity of demand (elasticity) measures the relationship between price and demand. An elasticity of -1.0 means that a 1% decrease in price will cause a 1% increase in demand. An elastic product or service generates a large demand response for a small change in price, and its elasticity will be below -1.0.[99] An inelastic product generates a small demand response for a large change in price, and its elasticity will be between zero and -1.0.

Two kinds of elasticity are relevant here: the elasticity of the *service* and the elasticity of *individual firms* in that market. For an essential service, the elasticity of the service is generally low. In a competitive market, however, the elasticity of the firm is generally high. This means that customers in competitive markets are often willing to change providers in response to a price increase, but not to drop service.

Whether an ILEC customer switches to a competitor or drops service altogether, the effect on the ILEC is the same. In both cases the ILEC's revenues decline substantially, and its costs decline by a small amount, or not at all. Therefore, if the elasticity of the individual firm is higher than the elasticity of the service, then the former is the more important variable. The willingness of the customer to switch to a competitor is therefore the crucial question in deciding universal service questions such as whether an ILEC is likely to be forced into an economic death spiral.

Elasticity can change with price. A price increase of, say, $1, can sometimes generate a larger response if the underlying rate is high. But economists seldom find a clear choke point, where the demand curve bends sharply or becomes discontinuous. On the contrary, economists

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[99] Elasticity is defined as the percentage change in the volume of a service sold divided by the percentage change in the rate. Given that the demand for a product decreases as the price increases, all elasticities of demand are negative.

assume that every product and service has a demand curve that is smooth. Higher prices generally produce lower demand. A given price increase will generally deter some but not all customers from buying.

In sum, there is seldom a threshold rate level beyond which universal residential service is likely to be harmed. We have not found any published economic research that is particularly useful in identifying such a bright line rate, or choke price, where a universal service problem begins.

1. Elasticity of Telephone Service

Published research tends to report low price elasticity for local exchange service.[100] An economist would predict that a 10% increase in local monthly rates would cause a decrease in subscribership of about 0.2%, at most.[101] In other words, economists believe that telephones have become a necessity of daily life, and nearly all consumers will buy telephone service, even at a high price.[102]

National penetration rate patterns confirm that telephone service is inelastic and that most households treat it as a necessity.[103] From 1997 to 2012, the national penetration inched up slightly, from 94.0% of households to 95.9%. But the penetration data also show some income-based differences. Middle-income and rich American households remained at a relatively constant penetration rate during this period. For low-income households, however, while the penetration rate increased, it reached a maximum of only 92.0%,[104] suggesting that many low-income households have found alternatives to local exchange service.

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[100] Several studies in the 1990s estimated the elasticity of this service as a function of changes in the monthly rate. The results ranged between -0.001 and -0.026. Robert Crandall and Leonard Waverman, *Who Pays for Universal Service,* Brookings Institution Press, 2000, Table 5-1 (citing to Garbacz and Thompson, "Assessing the Impact of FCC Lifeline and Link-Up Programs on Telephone Penetration"). A more recent study found elasticity to lie between -0.016 and -0.022. Daniel Ackerberg, Michael Riordan, Gregory Rosston, and Bradley Wimmer, *Low-Income Demand for Local Telephone Service: Effects of Lifeline and Linkup, 2011,* http://www.columbia.edu/~mhr21/papers/ARRW.pdf.

[101] This estimate applies to low-income households, which are presumably the most elastic of all.

[102] We also found research on the effect of Lifeline and Linkup. Lifeline is a subsidy program that assists low-income telephone subscribers pay monthly subscriber fees. It is one of the programs that Vermont currently funds from the VUSF surcharge. Linkup helps low-income customers pay connection charges for new telephones. A recent study found that Lifeline and Linkup subsidies increased the telephone penetration of poor households by 4.7 percentage points. Ackerberg, et al., above.

[103] The FCC's penetration data are based on U.S. Census Bureau surveys. A consumer would respond to the Census survey affirmatively if she has wireline, wireless, or VoIP service.

[104] FCC, Universal Service Monitoring Report, CC Docket No. 98-202, (data received through October 2012), Table 3.2 and Chart 3.2.

As explained above, the key fact for universal service is the elasticity of individual firms, not of telephone service. Penetration data cannot speak to this issue. We have not found any useful published research on this key topic. We understand that the Vermont ILECs believe that individual firm elasticity is high, and they have accordingly been reluctant to raise local rates. We cannot say that these perceptions are erroneous, particularly when cable television competitors who offer voice service can also sell video and therefore have a potential for greater average revenue per subscriber.

2. Elasticity of Broadband

Broadband appears to follow a similar pattern, but with some important differences. First, elasticity is declining, meaning that broadband is rapidly becoming a necessity. One study showed that broadband demand was relatively elastic in 2005, but by 2008 the elasticity had declined to -0.69. This means that an economist would predict that a 1% price increase in broadband would likely reduce demand by about 0.7%.[105]

Second, customers are sensitive to price, and they will abandon broadband entirely if the price is too high. One study reported a low elasticity (-0.53) at a $20 monthly price range but a much higher elasticity (-3.34) at a $70 monthly price. This result conforms to classical microeconomic theory, under which fewer and fewer customers are willing to buy a good or service as the price increases.[106]

The elasticity of individual firms appears high for broadband service.[107] While most households seem to value broadband, they don't seem to care very much about which provider they use. If one form of broadband becomes noticeably cheaper than another, broadband users seem to flock to that option. This high elasticity of individual firms suggests that the rates charged by broadband providers are likely to cluster at a particular level. In fact, broadband rates do seem to cluster at about $40 to $50 per month.

B. Effects of Competition

The 2012 legislation that chartered this study requires that this report:

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[105] The study found elasticity for broadband to be -1.53 in 2005 and -0.69 in 2008. The 2008 finding means that a 10% increase in price would be predicted to reduce customer take rates by 7%. Mark Dutz, Jonathan Orszag, and Robert Willig, "The Substantial Consumer Benefits of Broadband Connectivity for US Households," July 14, 2009. See http://internetinnovation.org/files/special-reports/CONSUMER_BENEFITS_OF_BROADBAND.pdf.

[106] Paul Rappoport, Lester Taylor, and Donald J. Kridel, "Willingness-To-Pay and the Demand for Broadband Service," in Allan L. Shampine, ed., *Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies*, 2003.

[107] Dutz, Orszag, and Willig, above. Elasticities of individual broadband technologies were approximately ten times higher, ranging from -4.0 to -9.9.

Estimate the potential effects of local exchange competition on uniform and affordable basic telecommunications service charges in all parts of the state.

When the Congress first mandated local exchange competition in 1996, pundits forecast widespread competition within only a few years. It was foreseen that competitive local exchange carriers (CLECs) would soon be operating over wide areas of every state. As it happened, local exchange competition has arrived in more limited, varied, and location-specific ways.

Volume II of our report discussed some of the economic challenges facing ILECs. We found that some Vermont ILEC service areas have a highly dispersed population. This makes it more costly for the ILEC to serve these areas, but it also makes it costly for competitors.

We also found that location density is a reliable predictor of the percentage of locations served by cable.[108] This is not surprising because, as is also true in other states, Vermont allows cable companies to limit their networks to more densely populated areas.[109] As a result, two-thirds of the locations in Vermont actually have access to cable service, but cable service is available to less than two-thirds of Vermont's acreage or roadways.

We also found that cable competition was a chief cause of ILEC line loss between 2008 and 2011. Since cable buildout has occurred chiefly in more densely populated areas, it is not surprising that ILECs with high location densities also lost more lines during this period.

Competition varies by service type. We view telecommunications as a combination of at least three sub-markets: (1) a stand-alone voice service market, (2) a bundled services market, and (3) a wireless market. Each of the three services has unique characteristics that allow providers to exploit market power in different ways.

In our opinion, the stand-alone market still seems generally dominated by the ILECs. In part this is because the ILECs still have some areas that do not have effective wireline or wireless competitors.[110] In part it is because the ILECs still offer the best value to some

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[108] The linear correlation of study area data between location density and percentage of locations with cable is 0.84.

[109] See Public Service Board rule 8.313(C).

[110] It is generally accepted among economists that a firm does not face effective competition if it can increase price by more than 5%. Recently, some large ILECs in urban states have substantially raised their rates. For example, AT&T-California increased its residential basic local exchange rate from $10.69 to $23.00. *AT&T advice Letter Summary Sheet to the California Public Utilities Commission*, January 2, 2013. AT&T has increased its local rates in major Texas cities from between $9.28 and $11.23 to $23.00. See http://cpr.att.com//pdf/tx/h001.pdf. Anecdotal reports suggest similar actions in at least two other states. Also, Verizon-Virginia increased its residential basic local exchange rate from $13.59 to $21.30. We view these rate increases as strong evidence that ILECs are still dominant carriers in the stand-alone market and do not face effective competition.

customers. Low-volume voice users typically can find an ILEC service that is lower cost than those typically offered by mobile carriers. Traditional ILEC technology also has some technical advantages, including the ability to provide central office power to customer homes during electric grid outages. The ILEC dominance in the stand-alone voice market is greatly reduced and may have ended in Vermont's urban and near-urban areas.

Cable services are strong competitors, both technologically and financially. They offer competitive LEC services in geographic areas where they have previous built cable systems.[111] Cable modem broadband service generally has higher speed capacity than DSL, which is the ILEC's competing product. Cable's pricing for Internet and voice is also competitive. A rational customer who already takes cable television service therefore would seriously consider moving her voice and Internet service over to the cable provider and buy the cable triple-play service.

In the bundled service market, cable providers can dominate in part because many households currently buy television services. For these customers, a cable company can provide a comprehensive bundle of services and a single monthly bill for voice, broadband, and television. Some cable companies, notably including Comcast, also have a strong purchasing power advantage over video content.[112] Cable providers might begin to lose market share in the future because customers are discovering they can drop traditional cable service and begin to obtain their entertainment through the Internet.[113]

Wireless is also a major competitor for local exchange service. Wireless offers the convenience of mobility and a variety of service applications, and it has many millions of customers who consider mobility an essential component of a telecommunications service.[114] The wireless industry is increasingly emphasizing data services, although wireless networks generally impose substantial charges on heavy data users.

Mergers and acquisitions have reduced the number of wireless providers over the last 15 years. The FCC entirely preempts the field of rate regulation for mobile wireless, and it has seldom interfered with a wireless acquisition or merger. The FCC's limited supervision of rates in this industry has allowed larger carriers to develop market power over roaming rates.[115] This in turn has created incentives for many smaller wireless providers to sell, to merge with the larger carriers, or simply to stop providing wireless service.

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[111] Some ILECs provide cable service to their own telecommunications service areas. Waitsfield, for example, provides cable in the Waitsfield exchange but not elsewhere in its service area.

[112] Comcast acquired 51% of NBC in January 2011.

[113] This consumer trend could accelerate if video streaming of live sports events becomes a common practice.

[114] It is hard to imagine that individuals who have cut the cord and now only have wireless service would return to wireline service if the wireless rate were to increase by 5%.

[115] These are the rates that wireless carriers charge one another for use of their towers.

Cable and wireless competition has caused a large portion of the ILEC subscriber losses. As we reported in Volume II, from 2008 to 2011 every Vermont ILEC lost subscribers. FairPoint NNE lost more than one subscriber in four, and Ludlow lost about one subscriber in five. At the other extreme, Franklin, Shoreham, Topsham, and Waitsfield have each lost less than one subscriber in ten. Location density and cable overbuilds explains much of this line loss.[116] Exchanges with the highest densities have the most cable competition and have lost the most lines. Line losses were also undoubtedly affected by variations in competitive conditions as well as each company's service quality history.

Competition is often thought to restrain excessive prices. In the preceding section we discussed academic findings that consumers who have choices among broadband providers are very sensitive to price differences. Competition does appear to have had a restraining effect on ILEC prices nationally. As noted above, Vermont ILECs profess that they are unwilling to raise rates because they believe they will lose customers.

The U.S. government's antitrust agency guidelines assert that a company has market power if the company can increase price by 5% and sustain that increase.[117] In our opinion, dominant carriers in all three telecommunications sub-markets can sustain 5% price increases.[118] Therefore, we believe that each of the markets (basic service, bundles, and wireless) is less than fully competitive. While there is substantial inter-platform competition, it is geographically limited. We do not recommend that Vermont rely solely on competition to ensure that customers receive uniform and affordable basic telecommunications service.

C. Effects on Economic Development

The 2012 legislation that chartered this study requires that this report:

> Estimate the relationship between basic telecommunications service charges and opportunities for uniform economic development throughout the state, and the threshold prices beyond which such opportunities may be adversely affected.

We did not find any academic research that related economic development to the level of basic telecommunications service charges. We did find some research that tends to show how investments in broadband facilities and broadband access affect economic development. Some of that literature looks at poorer, less-developed economies; other work focuses mostly on rural areas of the United States and other developed nations.

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[116] The unweighted correlation among ten study areas is 0.78.

[117] U.S. Department of Justice and the Federal Trade Commission, *Horizontal Merger Guidelines,* http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf.

[118] See note 111 above.

In general, academic research shows that investment in information and communication technologies increases economic productivity. While these results are not directly applicable to Vermont, they tend to show that investments that increase access also tend to increase economic productivity.

For example, a 2005 study of international data found that an increase in access to telecommunications networks tended to slightly promote gross domestic product.[119] The effect was stronger for middle-income countries that initially have at least 15% network penetration. While this study did find a correlation, the underlying causal relationship is not clear. There are some possible causal links from broadband to higher productivity,[120] but other explanations are also plausible.[121] Therefore, the 2005 international study has uncertain value to Vermont.

More directly relevant to the United States is a 2005 study based on FCC and Census demographic data. The authors found that between 1998 and 2002, communities in which mass-market broadband was available by December 1999 had experienced more rapid growth in employment, in the number of businesses overall, and in businesses that relied on information technology.[122]

A 2007 study also looked at U.S. data only. The authors found that states with higher broadband penetration rates tended to have higher output of goods and services.[123] They also found that such states had employment rates that grew faster over time, both in general and in particular industries, including manufacturing, finance, education, and health care .[124] There are

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[119] When access to telecommunications networks increased by 1%, there followed a 0.3% increase in GDP. Maximo Torero and Joachim von Braun, *Information and Communication Technologies for the Poor,* International Food Policy Research Institute Policy Brief, 2005. This study used 20 years of data from 113 countries.

[120] For example, broadband could promote new and innovative applications such as telemedicine and online education that increase productivity. In addition, broadband could promote new forms of commerce or the customization of products that allow local artisans to provide specialized products to a larger market, or broadband could facilitate the elimination of excess inventories.

[121] It is possible that a third factor drives both increased broadband deployment and greater economic development.

[122] William Lehr, Carlos Osorio, Sharon Gillett, and Marvin Sirbu, *Measuring Broadband's Economic Impact,* Working Paper, International Telecommunications Union, 2005.

[123] Robert W. Crandall, William Lehr, and Robert Litan, "The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data," *Issues In Economic Policy,* No. 6, July 2007.

[124] The authors found that a one percentage point increase in a state's broadband penetration rate tended to increase the state's rate of employment increase by 0.2 to 0.3% per year, with a cumulative effect year after year.

technical problems with the study's economic model,[125] and we doubt that the study's estimated high employment impacts of broadband deployment could be duplicated in Vermont.

A 2009 study considered the possible impact of the FCC's Broadband Stimulus Plan. The authors expressed some concerns.[126] First, they noted that broadband's effects on employment can vary in a complex way based on the current broadband adoption rate. At a low adoption rate, a small increase in broadband penetration may have no effect on employment. Once the adoption rate crosses a threshold, however, further broadband adoption could strongly promote employment, as states with higher broadband rates attract early-adopter businesses that depend heavily on broadband. Ultimately, broadband can reach a saturation point where most of the businesses and individuals that can benefit economically from broadband already have that service. At that point further increasing broadband adoption may not have a large impact on employment.

The 2009 study also noted that additional broadband adoption could reduce employment. First, it could produce a substitution of capital for labor. Second, it could reduce employment by facilitating outsourcing of labor.[127] Any such effects would tend to reduce the link between increases in productivity and growth in employment.

In conclusion, there is some evidence that states and countries that invest in broadband experience do benefit from increased economic growth. We caution, however, that it may be necessary to invest in complementary programs to ensure satisfactory job growth. We did not find any basis to advise Vermont that it should avoid any particular rate threshold in order to avoid harm to economic development.

III. Principles for Designing a Support Mechanism

Universal service programs serve a variety of competing goals. This section recommends several principles that Vermont should consider as a framework for a high-cost universal service support program.

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[125] The regional dummy variables on page 8 of the study are highly correlated to the independent variables. Moreover, the study failed to control for two possibly important variables: outsourcing and other sources of economic growth, such as the new energy development activity in the Dakotas.

[126] Raul Katz and Stephen Suter, *Estimating the Economic Impact of the Broadband Stimulus Plan*, Columbia Institute of Tele-Information, February 2009.

[127] To offset the outsourcing effect, governments could encourage insourcing complementary activities, such the encouragement of call centers and job training.

A. Effectiveness; Availability of Essential Service

We recommend that the Vermont Legislature establish a goal that any high-cost universal service support should be effective at maintaining and expanding the availability of essential services. Each of these key terms should be well defined by statute or by administrative rule.

The first key term is "essential service." We discuss below whether this should cover voice, broadband, or both.[128] Whatever Vermont decides, supported carriers should be required to offer the essential service over a well-defined area. Service areas should be mapped with precision, and boundaries should be readily available to the public through online maps.

"Availability" also should be defined. A service is "available" in a service area if any person with a residence or business located within the service area is able to subscribe to the essential service, subject only to paying a reasonable connection charge and, if necessary, a reasonable line extension payment. This kind of obligation is called a "carrier-of-last-resort" (COLR) obligation.[129] It was COLR obligations that historically caused ILECs to build lines to nearly every residential and business location in the state.[130]

Support should be effective at maintaining and expanding the availability of essential service.

B. Affordability

Affordability has been a traditional goal for universal service programs. One traditional definition has been to reduce the rates of low-income households. The Vermont Lifeline

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[128] The definition of broadband is an evolving concept. We discuss below a specific speed recommendation.

[129] Under historical COLR policies, Vermont telephone companies must find private capital to build their central offices and to purchase telephone equipment and switches. But they also must extend their lines to serve nearly every location in the state. Most customers seeking service from a COLR obtain a free "drop" from a nearby pole, and these short line extensions are routinely constructed at common expense. Longer line extensions are constructed at the requesting customer's expense. Line extension policies thus define the outer limits of each utility's COLR duty.

Some states use the term "providers of last resort" (POLRs). Under federal law, the concept of "eligible telecommunications carriers" (ETCs) is similar. See 47 U.S.C. § 214(e) for federal definition and duties.

[130] COLR networks typically extend farther into the countryside than the networks built by cable television systems. COLR networks sometimes extend farther than wireless networks, but wireless networks also occasionally cover unpopulated areas where COLR service is not available.

program performs this function now. The option of broadening the existing Lifeline program is discussed in section V.B below.

A second meaning is to ensure that essential services are affordable for the average person. Affordability can be measured either in the form of a target rate for the essential service or as the percentage obtained when dividing that rate by the area's typical income.[131]

It is increasingly difficult to articulate a simple definition of affordability in this second sense. Service providers have differentiated their offerings over the years in ways that make it more difficult to measure when a service is affordable. Rates can vary based on whether the customer wants to buy voice service, a toll package, broadband, or higher-speed broadband. Price can also vary by the volume of data that the customer sends through the network. "Affordability" thus becomes a more complex concept that could potentially address the affordability of a multitude of service bundles.

We suggest that Vermont define affordable rates for a telecommunications package that allows the average family to participate fully in society at a level which a household earning the state's median family income can afford. Vermont might follow other states in relating the affordability definition as a percentage of median income, say 2%. The components of such a telecommunications package would evolve over time, but a failure to define and periodically modify such a package could mean that many families are left behind in the new broadband world.

Rates should be affordable so that a household earning the Vermont median family income can afford a telecommunications package that allows the family to participate fully in society.

C. Sufficiency

Sufficient support means that high-cost universal service payments will ensure that essential service can be available everywhere in the state. The support budget must be large enough to allow a supported provider to continue providing ubiquitous service when it would not or could not otherwise do so. Stated another way, support is sufficient if it goes only to carriers that provide service in high-cost areas where private capital has reasonably judged that it cannot make a sufficient return without a subsidy.

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[131] Expressing the affordability goal as a percentage of income complicates matters in two ways. First, it suggests a periodic need to re-benchmark the support mechanism as the economy adjusts prices over time. Second, it suggests that areas with lower typical incomes should have lower rates, a principle that is unusual to utility ratemaking and that would be complex to administer.

Sufficient support benefits both individual customers and geographic areas. It produces affordable services for individuals, including residential households and business customers. It also promotes more uniform economic development.

Sufficiency also implies an upper limit to support. If support exceeds the amount needed to maintain service, it is more than sufficient. In sum, sufficiency suggests an ideal balance point – just enough, but not too much – to keep service available in high-cost areas.

The traditional approach to sufficiency was to support high-cost providers, without regard to revenue from telephone or other operations. We suggest an alternative approach that looks at the business case of the supported carrier. That business case must consider all the financial factors likely to affect the carrier's ability to continue operating, and it must include a prediction of both revenues and all reasonable major costs, including capital and operating costs. At its best, a universal service support mechanism approximates the accuracy of the data used for the business plan of a real company.

Support should be sufficient to the task of ensuring service remains available everywhere in the state, but no more.

Support mechanisms can also impose external constraints on revenues or costs for policy reasons, such as to promote efficiency or to promote adequate investment. It is important to remember, however, that adding such external constraints can compromise the main objective of maintaining service in unprofitable areas.

Federal legal distinctions make it more difficult to calculate the amount of sufficient support. Carriers in the U.S. have come to consider many of their network services as "preemptively deregulated," meaning that federal law prohibits states from regulating the rates, terms, and conditions for these services. It can be argued that these federal decisions should make "non-regulated" operations invisible to states for all purposes. That argument is unsound, however, because USF support is not rate regulation. In this context, Vermont has a legitimate need to know all the business circumstances of a provider who would receive a discretionary state subsidy. Willfully blinding the state to one or more categories of operations would reduce the probability that a high-cost program will be effective.

We recommend that VUSF high-cost support consider costs and revenues incurred by the network that are likely to affect the continued operation of the supported carrier. Specifically, we recommend that the analysis include basic (local voice) operations, long-distance (toll) operations, and broadband operations, even where those services are provided by affiliates.[132]

[132] We recognize that developing such a comprehensive financial picture is unusual for companies and can be particularly challenging for regulators who are accustomed to dealing with only a subset of these

We also recommend making an exception for video operations. Certainly, video is an essential and profitable element in triple-play offerings by cable television companies. If video is indeed essential to a supported carrier's sound business plan, then the profit and loss from video operations might also be included in VUSF calculations. Yet we recommend disregarding video for other reasons:

- Video-capable networks can require higher bandwidth capacity and are therefore more costly. Support demands could increase if the underlying network is engineered to provide video service.

- Many customers today have dropped their subscription cable service in favor of Internet video. Cable video service may become even less essential as other Internet-based video streams mature.

- Most video providers report their principal cost as video content. Yet some of those content providers are actually competitors in telecommunications. Comcast, for instance, controls NBC, which provides some popular sports programming. Wholesale content rates are completely unregulated, and video programming prices can be a competitive weapon. As a result, small ILECs that offer video service often lose money on those operations. In the end, a VUSF that recognizes video losses would risk providing a subsidy to those operations, and the benefit would likely flow to content providers with market power.

A comprehensive view of a company's business plan also must recognize federal funding. From a VUSF perspective, federal USF support is just one of many forms of revenue available to a supported company. In addition, some federal support amounts to capital contribution. Operating support and capital contributions are equally useful whether from public or private sources. High-cost support from the VUSF therefore should be provided only after considering the effect of all federal support.[133]

VUSF high-cost support calculations should consider all costs incurred by the network operations of the supported carrier and its affiliates, including basic local voice, toll, broadband, and federal USF support, but not video.

operations. State regulators traditionally review only the intrastate component of regulated operations. This approach excludes several classes of financially relevant information.

[133] Further, it would be reasonable to consider onetime grants to supported carriers as capital contributions, to be treated in the same manner as line extension charges prepaid by customers.

A realistic business plan also recognizes the effects of competition on ILEC operations. Competition can reduce overall costs by forcing the ILEC to be more efficient. At the same time, competition can increase average cost by thinning out the subscriber base without greatly reducing cost. Stated another way, competition leaves total costs largely unaffected but divides the available pool of subscriber revenues into more pieces and thereby reduces profitability. In sum, when a VUSF-supported carrier loses customers to a competitor, its business prospects generally worsen.

As the 1996 Congress understood, competition and universal service are competing goals that are often in conflict. Vermont policymakers should also understand that while competition remains an important goal, it creates additional problems in rural areas. We therefore recommend that VUSF high-cost support calculations adjust the reasonably expected revenues of supported carriers based on the extent of competition faced by those carriers.

VUSF high-cost support calculations should reflect reasonably expected revenues of supported carriers, after considering the effects of competition.

D. Financial Limits

Sufficient support can be very costly. We found in Volume II of this study that Vermont ILECs suffered an aggregate net operating loss in 2011 on their regulated operations of $11 per location per month. The companies that experienced these losses – FairPoint, TDS, and VTel – serve 92% of the locations in Vermont.

Looking more broadly at the future, we also predicted that, on an all-in basis, Vermont ILECs will have an aggregate operating loss of $70 million in 2013. We predicted that only two of seven owners would make a profit in 2013. We see little reason to think that the finances of these companies will improve thereafter.[134] The $70 million figure suggests a possible scale for the universal service task.

An important goal for a state universal service mechanism is to work within realistic financial parameters, considering limits to the contribution mechanism that provides the funding. Budgeting USF support is not a new idea. The FCC has explicitly established budget limits for federal high-cost programs. Many states have adopted de facto budgets as well, although the limits can be implicit and are often enforced through legislative votes.

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[134] In our opinion this conclusion will not change materially even if FairPoint receives additional federal support under the FCC's CAF II model program. Continued revenue erosion will be more likely if the courts sustain the FCC's 2011 *USF/ICC Transformation Order* that mandated lower access charges. An appeal is pending.

Vermont statute limits the VUSF rate at 2%, although it applies broadly to both intrastate and interstate revenues. This is much lower than the federal rate, which is currently about 15% on interstate end-user charges.[135] Nebraska, which has a well-funded state high-cost program, has a surcharge rate of 6.95% on intrastate end-user charges. Many other states impose much lower surcharge rates. Approximately half the states have no explicit high-cost programs at all.

Vermont currently imposes a VUSF surcharge with a maximum rate of 2%. The maximum plausible VUSF surcharge rate is a political question on which we cannot offer expert advice. From a variety of sources, however, we understand that the practical upper limit for the VUSF rate, including high-cost support, is 4%. We also discuss below the possibility that the revenue base could be expanded by requiring contributions from broadband. Such an expanded base could produce considerably more support. Whatever Vermont decides about the future rate, we recommend that the Legislature continue to set a maximum rate in statute.

If Vermont continues to levy VUSF surcharges solely on retail telecommunications revenues, an increase from 2% to 4% would produce approximately an additional $7 million of revenue for high-cost funding.[136] This is only a small portion of the ILECs' $70 million expected operating losses in 2013. With funding at this level, Vermont will likely have to make some hard decisions about what its high-cost program can achieve. Fortunately, policy options exist (discussed in Section IV below) that can reduce budgetary needs. These include compromises with reliability (for example relying on alternate technologies) and compromises with ubiquity (such as declaring some areas ineligible for support).

VUSF support should be subject to financial limits set by law, such as the amount of money generated by a 4% VUSF surcharge in telecommunications services, and possibly including broadband services.

E. Carrier Efficiency and Investment

Universal service programs create carrier incentives. A well-designed program will encourage carriers to operate efficiently, but also to spend adequately on capital to modernize and adequately maintain the network. Efficiency and adequate investment are important but competing goals.

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[135] The federal USF rate for the third quarter of 2013 is 15.1%. Historically, the highest assessment factor was 17.9% in the first quarter of 2012. Interstate end-user charges are only a portion of a customer's monthly bill for local service, typically consisting of the SLC charge and the ARC charge.

[136] The current contribution base for the VUSF is $354,381,000 of annual assessable revenues.

Classical rate-of-return regulation has often been criticized for encouraging wasteful operating expenditures and wasteful capital investments. For many years, the FCC and the Vermont Public Service Board have used price-cap plans to encourage greater carrier efficiency. A price-cap plan in its pure form allows a carrier to change its rates each year equal to the net change in long-run industry costs, which reflects both industry productivity changes and industry cost changes.[137] If the carrier can keep its costs below the industry trend, its profits increase. This profit incentive rewards carriers that eliminate inefficiencies.

Price-cap regulation has often been criticized as having the unintended consequence of reducing both service quality and investment. The same strategies that reduce and increase profits under a price-cap plan can also produce insufficient investment and maintenance. Indeed, many states have found that the geographic areas with the oldest networks and least-developed broadband service are precisely those areas where the FCC has kept the local ILEC under a price-cap plan for the last 20 years.[138]

A well-designed universal service fund seeks to promote useful investment while also discouraging wasteful expenditures. To achieve this, the USF plan must be carefully coordinated with the rate regulation plans that apply to each supported carrier. We specifically recommend that Vermont's universal service support mechanism should, working in tandem with the state's system of rate regulation, create incentives to discourage waste but also to encourage adequate maintenance and network modernization. If a carrier has a price-cap plan, the VUSF mechanism may need to create incentives for new investment.

Support should create incentives to discourage waste but also to encourage adequate maintenance and network modernization.

F. Economic Development

The principal goal of universal service is affordable rates and universal subscribership. These benefits flow to all users of the public switched network. With a ubiquitous network, every citizen can make or receive calls and can send and receive data, even from rural areas.

Economic development can be a second important goal. As a rural state, Vermont is well aware of the need to deploy infrastructure evenly throughout the state. Areas without adequate

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[137] Due to the difficulty in determining productivity growth, some regulators freeze prices, relying on the assumption that productivity growth equals inflation.

[138] Vermont's only price-cap carrier, FairPoint, is under a state price-cap plan that has an additional feature called a retail service quality plan.

bridges and highways cannot hope to compete economically. Likewise, areas without good broadband will be economically disadvantaged. Telecommunications may be even more fundamental because it makes some home occupations and small business activity possible even in areas with poor roads and few large employers.

We recommend that Vermont articulate uniform economic development goals for its universal service programs.

Vermont should articulate uniform economic development as a goal for its universal service programs.

IV. Threshold Policy Issues

We have been asked to examine policy options by which the cost to customers may be managed so as not to jeopardize universal service and uniform economic development opportunities. There are hundreds of possible permutations of universal service programs, and it is impracticable to list them all. Instead, in this section we present several preliminary issues. If Vermont policymakers answer these questions first, they can more easily select the most appropriate support mechanism and decide how much funding will be needed for high-cost support.

A. Coverage Goals

Rural exchanges usually have few customers, and those customers have long loops that sometimes use miles of dedicated copper wire. Moreover, rural exchanges tend to have higher average cost for electronics equipment in the central office, because smaller boxes often cost more per subscriber served.

The result is that ubiquitous coverage can be costly. We explained in Volume II that there are some exchanges in Vermont that have quite high costs, above $100 per subscriber per month. A wireline network that serves 100% of Vermont locations is much more costly than a wireline network that serves only 95% of locations.

It is worth noting that after a century building landline networks to provide voice service, Vermont's ILECs have achieved full coverage only approximately. Vermonters who have built houses on rural, class 4 roads often find that after a few years of living off the grid they want to acquire electric and wireline telecommunications services. These customers can be surprised by the large line extension charges they must pay to their local electric utility or ILEC before they can receive service.

On the other hand, new technologies reduce the cost of ubiquitous coverage. Terrestrial wireless and satellite technologies can substitute for landlines and can reduce costs. The cost of maintaining the most efficient network platform everywhere could be considerably lower than the cost of supporting the ILEC network everywhere.

We recommend that Vermont explicitly decide whether universal coverage is a state goal.[139] Further, we recommend a goal that service will be available in 100% of Vermont's business and residential locations. This goal does not imply that any particular technology, platform, or provider is inherently preferred.

Vermont should set a goal that service will be available in 100% of the business and residential locations in Vermont.

B. Defining the Supported Services – Voice and Broadband

A second key question for Vermont universal service policy is whether Vermont's ubiquitous network should be capable of providing voice service, broadband service, or both. As discussed above, basic voice service, excluding toll service, was the key objective of the 1994 legislature that created the Vermont Universal Service Fund. It also was apparently the chief concern of the 2012 Legislature that authorized this study.[140]

Since 1994, voice and broadband have virtually changed places. Broadband has become an essential service to residences and businesses alike. While still important to consumers, voice service can ride on top of broadband, like a small surfer on a large broadband wave. Voice can thus be viewed today as merely a broadband application, one that is not fundamentally more difficult for a provider than giving access to Google or Facebook.

We recommend that the next revisions to Vermont's universal service statute define essential service to include both broadband and voice. Customers are increasingly demanding

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[139] Universal coverage is already an established goal in Vermont. See 30 V.S.A. § 7501(a). Because of its importance, we nevertheless recommend expressing this goal in any VUSF bill passed by the Legislature.

[140] The statute expresses concern for "telephone service" and for "local exchange service" provided by "incumbent local exchange carriers (the providers of last resort)." Vermont Acts of 2012, No. 169, Secs. 1(a)(1).

broadband from their telecommunications providers. As noted above, 78% of adults use the Internet, [141] and tens of millions of those users use broadband.[142]

Financial reasons also suggest including broadband in the definition of essential service. No telecommunications company today is likely to survive by providing only voice service. Therefore no universal service program is likely to be successful if it ignores the costs and revenues available from broadband.

This recommendation appears consistent with recent actions by the Vermont Legislature and two Governors.

- In 2006, Vermont Act 172 established the policy that the state would "take an active role, through policy and funding, to promote development of broadband infrastructure and access to advanced telecommunications services in rural as well as urban communities in Vermont." The same act mandated a statewide review and inventory of regulations and procedures" that affected broadband deployment as well as "changes that are likely to stimulate broadband deployment throughout Vermont."[143]

- In 2007, a Vermont Department of Public Service report stated that Vermont was "committed, through law and policy, to the goal of providing ubiquitous broadband availability to Vermonters." That report cited an announcement by Governor Douglas that Vermont was committed to the goal of providing universal broadband service to Vermonters by 2010.[144]

- Substantial federal and state grant and loan dollars have been devoted to expanding broadband service.[145]

- Vermont's 2011 Telecommunications Plan made "universal adoption and use of broadband at home and at work" a key policy outcome desired by year's end 2013.

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[141] K. Zickuhr and A. Smith, *Internet Adoption over Time,* Pew Internet Report, available at http://www.pewinternet.org/Reports/2012/Digital-differences/Main-Report.aspx, accessed May 22, 2013.

[142] The FCC reports that the United States had 99 million fixed broadband connections at the end of 2011, and another 142 million wireless broadband connections. FCC, *Internet Access Services: Status as of December 31, 2011* (2013) (*2013 Internet Access Report*), Table 1.

[143] Vermont Acts of 2006, No. 172, Sec. 1.

[144] Vermont Department of Public Service, Access for All: Meeting Vermont's Broadband and Wireless Goals, a Report Pursuant to Act 172 of the 2005-2006 Session of the Vermont General Assembly, Feb. 2007, p. 1.

[145] Vermont provided $8.9 million in state funds to the Vermont Telecommunications Authority for capital investments from 2007 through 2012. Vermont Acts of 2012 ,No. 53, Sec.78.

- In 2012, Governor Shumlin, announced that Vermont's high-speed broadband network had expanded to reach an estimated 282,000 locations since 2010, and expected to serve every household and business in Vermont by the end of 2013.[146] Governor Shumlin reaffirmed this goal in January of 2013.[147]

In light of these developments in Vermont, the only possible recommendation is to support both voice and broadband as essential services. To recommend support for only voice service would ignore this history and the fact that voice is now only a small part of today's telecommunications market. Even more important, a voice-only recommendation would necessarily encourage Vermont to adopt a VUSF support mechanism that is based on an implausible business plan to provide only voice service.

The Vermont Legislature should define essential service to include both broadband and voice.

Broadband speed expectations are evolving. A decade ago, broadband simply meant a service better than the speeds available on voice lines, such as 28 kbps. In 2011 the Vermont Telecommunications Plan proposed defining "basic broadband" as non-satellite data transmission technology that provides two-way data transmission to and from the Internet with advertised speeds of at least 768 kbps (0.768 Mbps) downstream and at least 200 kbps (0.200 Mbps) upstream to end users.[148]

Many DSL networks are asymmetric, meaning that they were designed to perform better when moving data to the customer (downstream), than when accepting data from that customer (upstream). Upstream speed is a major constraint for the DSL service offered by ILECs. Sometimes a DSL provider can offer a customer a downstream speed of 6 Mbps but an upstream speed of only 0.8 Mbps.

Actual broadband speeds have risen markedly in recent years. A 2013 FCC study reported that the average subscribed speed for broadband in the United States is now 15.6 Mbps

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[146] Press release, *Gov. Shumlin, Karen Marshall Outline Progress Expanding Broadband Access in Vermont,* Dec. 28, 2012, http://governor.vermont.gov/Gov-Shumlin-Karen-Marshall-outline-progress-expanding-broadband-access-in-Vermont.

[147] Press release, *Governor Shumlin Announces Transition for Connect Vermont,* Jan. 22, 2013, http://governor.vermont.gov/newsroom-governor-shumlin-announces-transition-for-connect-vermont.

[148] Vermont Department of Public Service, *Vermont Telecommunications Plan 2011: Broadband,* at 6-7.

and that this sped is increasing at the rate of 20% per year.[149] As of the end of 2012, the FCC reports that 70% of residences in the United States are located in census blocks served by speeds of at least 3 Mbps, and 44% in census blocks served by speeds of at least 6 Mbps.[150]

The upper limit of residential broadband speeds is expanding rapidly also. A few cable television networks now offer 100 Mbps.[151] Landline fiber-to-the-home networks are still faster. Verizon recently announced a landline service at 500 Mbps,[152] and several cities now offer 1 Gigabit (1,000 Megabit) service.

Federal and state precedents do not seem to coalesce around a single obvious speed standard that could be adopted as a condition for future VUSF support.

- The 2011 Plan from the Department of Public Service proposed a goal that by 2020 every household and business location in Vermont ought to have access to affordable broadband service with actual speeds of at least 4 Mbps on download and 1 Mbps on upload.[153]

- Since 2012, the Vermont Telecommunications Authority has required download speeds of 5 Mbps for grant purposes[154]

- The FCC has established a standard of 4 Mbps downstream and 1 Mbps upstream for certain kinds of future federal USF funding.[155]

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[149] FCC, *2013 Measuring Broadband America: A Report on Consumer Wireline Broadband Performance in the U.S.*, February 2013, available at: http://transition.fcc.gov/cgb/measuringbroadbandreport/2013/Measuring-Broadband-America-feb-2013.pdf.

[150] FCC, *Internet Access Services: Status as of December 31, 2012*, at 3, available at http://transition.fcc.gov/Daily_Releases/Daily_Business/2013/db0520/DOC-321076A1.pdf.

[151] E.g., Daily Tech, *Videotron Launches 120Mbps Broadband Service in Canada,* Sept. 24, 2010. http://www.dailytech.com/Videotron+Launches+120Mbps+Broadband+Service+in+Canada/article19714.htm.

[152] Verizon announced that the 500 Mbps service will be provided to all its areas that have Verizon FTTH service by 2014. *Telecompetitor* (email newsletter), July 23, 2013.

[153] Vermont Department of Public Service, *Vermont Telecommunications Plan 2011: Broadband*, at 6-7.

[154] Vermont Telecommunications Authority press release, *Vermont Telecom Authority Awards Broadband Grant to FairPoint*, September 4, 2012, http://www.telecomvt.org/node/166, accessed May 30, 2013.

[155] Rate-of-return carriers receiving legacy universal service support or CAF support to offset lost ICC revenues must offer broadband service meeting initial CAF requirements, with actual speeds of at least 4 Mbps downstream and 1 Mbps upstream, upon their customers' reasonable request. The FCC adopted the

- For some purposes, the federal government uses a definition of broadband as at least 3 Mbps downstream and 0.768 Mbps upstream.[156]

- According to the FCC's 2010 National Broadband Plan, by 2020 the United States should have at least 100 million U.S. homes with affordable access to actual download speeds of at least 100 Mbps and actual upload speeds of at least 50 Mbps. In rural areas, the FCC's goals did not specify any speed, only that every American should have "affordable access to robust broadband service."[157]

We recommend that Vermont establish 4 Mbps downstream and 1 Mbps upstream as a minimum speed standard for VUSF support eligibility.[158] While this speed goal presents a financial challenge for some DSL systems and many wireless systems, we believe it is achievable in most areas of Vermont, particularly using newer technologies. It is a conservative goal that is below the current national average broadband delivery rate, it is well below the rates currently offered on cable networks.

We also recommend giving the Vermont Public Service Board authority to grant waivers to this speed requirement if the public interest so requires. A temporary waiver might be necessary as a carrier plans and deploys new facilities. A statewide waiver might be needed to keep VUSF high-cost support within its budget.

The Vermont Legislature should establish 4 Mbps downstream and 1 Mbps upstream as the minimum speed for supported broadband service. The PSB should be able to grant temporary waivers.

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same speed benchmarks for CAF recipients. FCC, WC Docket No. 10-90, *Connect America Fund, Report and Order and Further Notice of Proposed Rulemaking*, FCC 11-161 (rel. Nov. 18, 2011), paras. 22, 26, 94.

[156] See FCC, *2013 Internet Access Report*; see also National Telecommunications Information Agency, *Broadband Availability beyond the Rural/Urban Divide,* Broadband Brief No. 2, May 2013, http://www.ntia.doc.gov/files/ntia/publications/broadband_availability_rural_urban_june_2011_final.pdf (3 Mbps download speed defines "basic broadband").

[157] FCC, Connecting America, the National Broadband Plan (2010), at 9-10.

[158] Vermont law delegates to the Department of Public Service the responsibility of defining "minimum technical service characteristics which ought to be available as part of broadband services commonly sold to residential and small business users throughout the State." 30 V.S.A. § 8077.

C. Landline versus Wireless

Assuming that Vermont has defined the proportion of the state in which it wants ubiquitous service, the next task is to define acceptable technologies, or platforms. Foremost is the question whether Vermont wants *landline* service (wires or fibers). Stated the other way, Vermont must decide whether it is an acceptable outcome that the only telecommunications service available in some parts of the state will be terrestrial wireless service, satellite service, or both.

This question is complex and requires consideration of a range of factors discussed in the following sections. Especially given the severe financial constraints imposed by likely USF budgets, the ultimate answer probably cannot be a simple yes or no. Vermont could rationally decide, for example, that 100% landline coverage is too costly and that 5% (or 50%) of Vermont locations can be adequately served by fixed or mobile wireless service.

The following sections discuss nine factors that Vermont should consider in evaluating whether wireless services can meet the state's universal service goals.

1. Ubiquity

ILECs have had a century to build a ubiquitous network, and they have built a network that serves nearly every established residential and business location in Vermont. Replacing this network would be a complex task. Signal strength varies by location, season, and weather. Radio signals can be strong in one place and weak a short distance away. It often requires advanced engineering techniques to know how a radio signal will behave, and even then the predictions can prove wrong. The challenge is especially great in Vermont, which has many hills and trees that can affect wireless signals.[159]

2. Convenience

Wireless service is often a mobile service.[160] Mobile service is more convenient than landline service in many circumstances, which is undoubtedly why so many households and so many younger consumers have cut the cord and become wireless-only customers. Wireless also has notable advantages during local emergencies. Injured loggers, hunters, and motorists can make wireless 911 calls from locations without any accessible landline.

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[159] The latest wireless products operate at lower frequencies (such as 700 MHz), and they may be less sensitive to Vermont's challenging conditions.

[160] Some wireless services are fixed.

3. Network Congestion

Wireline customers are accustomed to highly reliable service. Except for the occasional cable cut by an errant backhoe, wireline networks are now more reliable than ever before. Electronic components have improved over time, and networks now even use self-healing routing technology that automatically routes traffic even around cable cuts. The wireline network traditionally has aspired to a reliability of 99.999%,[161] although even wireline networks increasingly rely on remote electronics that depend on batteries during a power failure.

Even with good signal strength, many mobile wireless users have experienced reduced voice quality and, on occasion, dropped calls during times of network congestion. The new 4G services offer customers large data capacities, further stressing existing facilities.

Spectral efficiency limits how many bits of data per second can be pumped through the spectrum for a wireless antenna.[162] A cell tower with a typical spectrum assignment might have a capacity of only 7.5 Mbps per antenna.[163] But a single 4G user might demand 4 Mbps of data. Two such 4G users cannot simultaneously get 4 Mbps from a cell tower that can handle only 7.5 Mbps.

In wireless networks the oversubscription ratio describes the ratio of total subscriber potential demand to the tower's total data streaming capacity. The wireless industry uses relatively high oversubscription ratios. For example, a major FCC paper issued in 2010 assumed a wireless oversubscription ratio of 25.[164] On such a network, every unit of capacity has 25 possible claimants. The higher the oversubscription ratio, the greater is the probability that a user will be denied service during a peak hour of a peak day or will experience degraded service.

As a result, wireless systems can be overwhelmed by an unexpected event that either concentrates many users in a single place or that causes mass simultaneous use. Usually these

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[161] In telecommunications parlance, this is called the "five-nines" standard.

[162] A typical cell tower might have 5 MHz of downstream spectrum (and a different 5 MHz allocation for upstream use). Some wireless networks use unlicensed spectrum, but these networks also face upper limits on the available bandwidth as well as interference from other unlicensed emitters. Directional antennas can increase the number of users supported by a given bandwidth allocation.

[163] A typical value for maximum spectral efficiency is 1.5 Mbps of data capacity per MHz of spectrum. This gives a tower with a 5 MHz allocation the ability to download 7.5 Mbps to all customers.

[164] Busy hour offered load (BHOL) is the expected network demand by typical customers during the busy hour on the average day. In the 2010 FCC study, the FCC assumed that wireless carriers would build networks with a BHOL of 160 kbps per customer in 2015. If the carrier advertises service at 4 Mbps, this would allow the carrier to sell 25 Mbps of capacity for every 1 Mbps of its network's actual capacity. See FCC, *The Broadband Availability Gap (OBI Technical Paper No. 1)*, (2010) p. 111; authors' calculations.

disturbances are temporary and are resolved routinely.[165] Nevertheless, because of these limitations, wireless networks must reduce the data delivery rate (or degrade or drop voice calls) when too many users seek service at the same time.

4. Future Capacity

Closely related to congestion is the question of whether wireless service is likely to match future customer demand. Currently, the FCC does not report on the data speeds typically provided by wireless broadband.[166] But another federal agency reports that wireless data speeds are already significantly lower than the fastest wired speeds.[167] There is little reason to think this wireless/wireline gap will close in the future, particularly since wireless networks face the unique physical limitations discussed above.

Customer demand seems likely to grow in the future, creating expectations for much higher speed. As noted above, the FCC has set a goal of having 100 Mbps download speeds available for 100 million homes in the U.S. [168]

Of course, wireless companies work vigorously to acquire more spectrum. In 2012, AT&T's chief executive officer told analysts that:

> The #1 issue for [AT&T and the industry] as we move forward . . . continues to be spectrum. This industry continues to see just explosive mobile broadband growth and is providing one of the few bright spots in the U.S. economy, but I think we all understand this growth cannot continue without more spectrum being cleared and brought to market. [169]

The federal government is making increased efforts to accommodate this spectrum demand, [170] but it remains to be seen whether a wireless network could ever provide a ubiquitous,

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[165] Also, wireless companies anticipating unusual user concentrations at a planned event can augment their capacity using portable cell towers.

[166] The FCC plans to include wireless broadband reporting in the future. FCC, *Connecting America: The National Broadband Plan* (2010), p. 53.

[167] National Telecommunications Information Agency, *U.S. Broadband Availability: June 2010 – June 2012,* May 2013, http://www.ntia.doc.gov/files/ntia/publications/usbb_avail_report_05102013.pdf.

[168] FCC, *Connecting America: The National Broadband Plan* (2010), p. 9.

[169] Fourth quarter 2011 earnings report to analysts, January 26, 2012, transcript available at http://seekingalpha.com/article/322378-at-t-s-ceo-discusses-q4-2011-results-earnings-call-transcript?part=qanda.

[170] President Obama issued a memorandum of June 28, 2010, directing federal officials to make 500 MHz of federal and nonfederal spectrum available for wireless broadband use within 10 years. He issued another memorandum on June 14, 2013, directing federal agencies to better coordinate the use of spectrum to "expedite the repurposing of spectrum and otherwise enable innovative and flexible

reliable, and widely used broadband service throughout Vermont at 4 Mbps, much less at 100 Mbps.

In sum, wireless data networks present factually complex but important questions about whether they can meet present and future demand for data services. For each area in Vermont, the answer will depend on spectrum allocation, on the number of likely users in the area, and on the provider's plans for oversubscription ratios.

5. Atmospheric Reliability

Copper wireline networks also are susceptible to moisture, and keeping cables dry is a continuing concern for wireline providers. Moisture problems are less serious with fiber facilities, as light fibers are not harmed by moisture in the same way as copper wires. In contrast, wireless services have different kinds of weather problems. They are susceptible to service disruptions in severe weather involving heavy rain or snow.

The effects can vary based on the frequency used by the cell phone or fixed wireless device. Some areas use Wi-Fi networks, which rely on a very high frequency signal that is strongly affected by rain and snow. The industry is today seeking access to lower frequencies, such as those used historically for broadcast television. If these lower-frequency signals become widely available, wireless service can become more weather resistant.

6. Disaster Resistance

Natural disasters interfere with all networks. Wireline and wireless services each have characteristic strengths and weaknesses that become important during natural disasters.

A traditional copper loop transmits both information and power, and most central offices have generators that can run indefinitely during an electric grid failure. These central offices are often directly connected to telephones within a mile or two of the central office. Under ideal circumstances, these customers will continue receiving telephone service during a power outage because the central offices generally have power generators. Central office power backup can be an important benefit in case of widespread natural disaster or emergency, such as a hurricane, that eliminates grid power for an extended period.[171]

Many ILEC customers do not have the benefit of this indefinite voice service during a power outage. First, cordless phones don't work without grid power, even when the telephone company dial tone is intact. Second, many wireline telephone customers today are served from

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commercial uses of spectrum, including broadband, to be deployed as rapidly as possible." See http://www.whitehouse.gov/the-press-office/2013/06/14/presidential-memorandum-expanding-americas-leadership-wireless-innovatio.

[171] Central office power also allows customers to report localized power outages to the power company using their telephones.

remote platforms that have batteries but not generators. Telephone companies generally cannot keep their remote platforms operating indefinitely following a grid power failure.

Wireline services have sometimes been prone to failure during flooding episodes, in part because wireline central offices are often located in low-lying downtown areas. Sometimes wireless facilities are located on higher ground and escape flood waters that affect landline facilities.[172]

Wireless services also have backup power, but it is often limited. Stand-alone cell towers typically have backup batteries,[173] but they do not always have fixed generators.[174] Moreover, some cell towers are located on buildings where it is difficult or impossible to install a generator or backup batteries. Wireless providers generally are able to reroute traffic flows to recover from localized failures.[175]

Cellphones and smartphones have batteries, but they also rely on commercial power for recharges. Even where the network is operating, there have been cases where mobile phone customers have had to drive to another town to recharge a cellphone battery.[176]

7. Existing Investment

Existing investment is another factor the Vermont Legislature should consider in deciding whether it wants landline service in all areas. In areas with existing adequate investment, the cost of supporting continued essential service will be lower.

As we explained above, wireline networks today serve almost every settled part of Vermont. In some areas like Topsham, these wireline networks are relatively new and have high capacity. Other areas have long loops and use older broadband technologies, if any.

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[172] After Hurricane Katrina hit New Orleans in 2005, for instance, cell phones worked in some areas where landline service did not.

[173] After Hurricane Katrina the FCC considered requiring wireless carriers to provide 8-hour battery backups. The FCC never acted on that proposal. Gabel and Burns, *The Transition from the Legacy Public Switched Telephone Network to Modern Technologies*, National Regulatory Research Institute, 2012, p. 21.

[174] Verizon Wireless has claimed that "more than 90% of Verizon Wireless' cell sites throughout New England have both backup batteries and permanent generators." Gabel and Burns, p. 22.

[175] A wireless network can temporarily transfer a customer's handset from a failed cell tower to a nearby working tower.

[176] During the 2011 Halloween nor'easter storm in New England, many people without electricity were forced into libraries and coffee shops to find power to keep their mobile devices working until power was restored to their homes. Gabel and Burns, p. 23.

Vermont has made a commitment to fixed wireless service. VTel Wireless has received substantial grants to expand wireless broadband service,[177] and wireless broadband may indeed cover most parts of the state in the near future. This commitment to a statewide 4G wireless network reduces the cost of building a new overlapping wireless network to provide broadband and voice, and it could therefore reduce the needed size of the VUSF.[178]

8. Network Independence

The Vermont legislature should consider network independence as another factor in deciding whether it wants landline service in all areas. As explained above, wireless networks often depend on wholesale service from wireline companies. Most cell towers, for example, are connected to backbone facilities using special-access lines rented from the local ILEC. If these rented backhaul circuits fail, the wireless company cannot get its signals between its backbone network and its cell towers. Also, some wireless carriers depend on the local ILEC for middle-mile transport of their signals.

If Vermont decides that wireless service in some or all of the state can meet the state's telecommunications requirements, it should evaluate the effects of a financial and service failure by the local ILEC. A wireless provider that seeks universal service funding should be able to demonstrate that it can continue providing essential service following such a failure.

9. Reasonable Rates

Price is another variable in deciding whether Vermont should declare wireless service eligible for universal service support. Unfortunately, differences in product design make it difficult to compare prices across platforms. Nevertheless, important differences in price do exist. Appendix A compares customer bills for typical wireline and wireless offerings. It contrasts similar plans from one ILEC (FairPoint), one cable provider (Comcast), one wireless company (Verizon Wireless), and Walmart. The table shows total bills offered to customers seeking four common service levels.

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[177] In 2010, Vermont Telephone Company said a federal grant would enable the company to build a fourth-generation wireless technology "Internet system to nearly all of Vermont's unserved homes, businesses and anchor institutions; a one gigabit fiber network to VTel's existing customers." Congressman Welch press release of August 4, 2010, available at http://www.welch.house.gov/index.php?option=com_content&task=view&id=1121&Itemid=. VTel has also received state funds from the Vermont Telecommunications Authority to reach the most rural locations. VTel press release of Sept. 4, 2012, available at http://www.vermontel.com/news/234-vtel-wireless-wins-broadband-grant.

[178] We understand that voice service is not currently available as a native service on 4G networks. Voice service can be provided over the top by nomadic systems such as Vonage. Therefore, we have no opinion as to whether the anticipated 4G VTel network will be capable of providing essential USF service in Vermont.

Appendix A shows some price differences among these typical Vermont providers:

- For traditional basic telephone (dial tone) service, Walmart offers the lowest price, since its $15 wireless Straight Talk plan includes all the traditional elements of basic service, plus more.[179] Nearly tied in second place, Verizon Wireless offers a Home Phone Connect plan at $20, and FairPoint offers a Low Use plan at $23.[180] The plans offered by Comcast and Verizon Wireless's mobile plan are more costly, at about $35, although both services have distinctive features and may appeal to some customers.[181]

- For a voice bundle that includes local and toll calling, Walmart's Straight Talk service has the lowest price, at $15 per month. Verizon Wireless's Home Phone Connect service is in second place at $20. These services will be attractive to customers who seek only voice service and who are located where wireless signals are strong. Comcast's and Verizon Wireless's voice bundle is more costly, about $50 per month. FairPoint's voice bundle price is highest of all at $67.

- For a bundle of voice and broadband data that provides 10 GB of data per month,[182] FairPoint's offering at $66 is least costly. Comcast's product at $76 costs slightly more. Verizon Wireless's two products are much more costly, at $110 and $142.

- For a bundle of voice and broadband data that provides 50 GB of data per month, the FairPoint and Comcast charges are the same as above. For the wireless options, however, the costs escalate. The monthly charges from Verizon Wireless are about $300 higher than the wireline charges.

Appendix A supports two broad conclusions. First, although basic telephone (dial tone) service is the central goal of the current Vermont USF statute, it has in some contexts become

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[179] The Walmart service is not compatible with data services such as home security systems, fax machines, DVR services, credit card images, or medical alert systems.

[180] The FairPoint Low Use plan allows customers to receive calls without any additional charge, and it gives access to emergency services. Every minute of usage, whether local or toll, can generate additional charges, although the maximum monthly charge is $39.40.

[181] Comcast's Xfinity Voice – Local with More plan includes unlimited direct-dialed local calling but imposes additional charges for toll calls. Verizon Wireless's basic prepaid plan includes 500 minutes of airtime that can be used for calls that, on landline, could be either local or toll.

[182] The FCC reported that 2009 average wired broadband usage was 10 Gb per month, and that annual per user growth has been between 30 and 35% per year. *USF/ICC Transformation Order*, ¶ 99. Wireless networks typically have lower data usage, in part because smartphones rely on a mixture of cell networks and Wi-Fi networks. On a wireless 4G network, 10 Gb would be used by someone who does 4G video streaming one hour per day (@ 350 Mb/hr) or audio streaming for 5 hours per day (@ 60 Mb/hr).

largely obsolete. As discussed above, some cable companies and VoIP providers today sell only this kind of bundled voice service, but do not offer basic telephone service alone.[183] Mobile wireless services have developed quite different classifications that do not match to the landline toll-local distinction. Since the newest toll bundles cost less than the traditional local services, consumers gain little by having the state maintain the traditional distinction between local and long-distance.

Second, wireless services are prohibitively costly for heavy data users. Given the spectrum limitations on these networks, there is little reason to anticipate lower data charges in the future.[184] A final complication is that states, including Vermont, have been preempted from regulating prices for mobile wireless services.[185]

These rates raise a serious question of whether wireless can provide the essential universal telecommunications service needed in Vermont. Rates will become an even more serious issue in the future if Internet demand continues to increase, particularly if the Internet replaces cable as the preferred video source. A customer who uses Hulu or Netflix for video entertainment could quite plausibly generate a monthly demand of more than 100 Gb.[186]

One view of wireless networks is that they are a supplement to, rather than a replacement for, wireline service. If wireless providers view themselves in this light, they may voluntarily refrain from seeking universal service status. For example, while preparing the prices listed in Appendix A, we discussed with Verizon Wireless the possibility of listing rates for a broadband customer who uses 100 Gb of data per month. Verizon Wireless explained that:

> The [Verizon Wireless] network today is not engineered and our plans and actual usage by consumers do not currently support the user types identified. The market will dictate if or how these users could be addressed

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[183] In Vermont, basic telephone service is still offered by ILECs and Comcast. CLECs and cable providers in some other states do not offer it as a stand-alone product. See, e.g., http://wwwb.comcast.com/corporate/shop/productoverview.aspx, accessed May 21, 2013.

[184] *See* Michael Balhoff and Bradley Williams, *State USF White Paper: New Rural Investment Challenges,* June 2013, p. 1 (wireless is not a replacement broadband service in part because wireless broadband pricing is increasingly volume-based and is expected to remain prohibitively high compared with far more affordable terrestrial services).

[185] 47 U.S.C. § 332(c)(3)(A) (preempts state regulation of commercial mobile service).

[186] We considered the demand from a customer who in a month watches eight movies (@ 90 minutes), four sporting events (@ 3 hours), 10 hours of news, 10 hours of children's programming, and 10 hours of other video. The total video usage would be 54 hours. We conservatively assumed 2 Gb per hour for HD viewing, which would mean that a 90-minute movie would use 3 Gb. The customer would use 108 Gb per month. This estimate excludes other kinds of Internet transactions, such as streaming audio, YouTube viewing, gaming, file sharing, and web browsing.

in the future but, today, these assumptions are best served by the application of land line solutions.[187]

10. Conclusion

We recommend that Vermont explicitly decide whether to create a goal of providing ubiquitous landline voice and broadband service in some or all parts of the state. Ideally, the question would be decided by the Vermont Legislature, based on a factual record addressing the issues raised in the preceding sections.

Vermont should decide whether wireless service can meet Vermont's universal service standards in some or all parts of the state. Ideally, this decision would be based on a factual record that considers such issues as ubiquity, convenience, network congestion, future capacity, atmospheric reliability, disaster resistance, reasonable rates, and the effects of wireline abandonment.

D. Terrestrial versus Satellite

Satellite broadband service is now available throughout most of the U.S. Satellite companies are launching new high-capacity satellites almost every year. In 2011, the satellite industry began launching a new generation of satellites offering performance as much as 100 times superior to the previous generation, leading to the entry of new satellite-based broadband providers. It is possible that some or all very remote areas of Vermont can most efficiently be served, within the limits of available funding, using satellite technology.

- Satellite technology raises several issues, many of which are similar to those issues raised in our discussion of wireline and wireless networks.Generally, satellite is more easily made ubiquitous than terrestrial systems. All or almost all Vermont locations can receive a signal.

- Satellite can be as convenient as wireline, assuming the customer uses a fixed dish. Signal coverage in remote and hilly areas can be better than terrestrial wireless.

- Network congestion is a smaller risk than for terrestrial wireless under conditions of localized demand. Satellite beams tend to cover larger areas than do cell

[187] E-mail from Verizon Wireless of Sept. 19, 2013.

towers, reducing the effects of local events. Also, satellites support multiple communication beams, and the providers can refocus those beams into areas of high demand. The FCC recently reported that sustained download rates from satellites exceed advertised speeds by 37%.[188]

- Future capacity is probably not a problem, as new satellites are being launched to match demand.

- Disaster resistance can be better than terrestrial service, so long as the customer has power to his or her own equipment. Floods do not affect satellites.

- Satellite rates are generally comparable to other services or a little more costly. Like wireless services, satellite services can have monthly data caps.

- Shifting to satellite could harm ILECs more than shifting to terrestrial wireless. Wireless companies generally buy backhaul from cell towers, but satellite companies do not.

Latency and atmospheric conditions are the principal problems with satellites. Satellite broadband service generally means service from geostationary satellites. These services usually allow users to set up a small dish and continue receiving signals so long as the dish isn't disturbed. But geostationary satellites are located 23,000 miles above the earth. This creates a latency, or delay, of about ¼ second or more.[189] Latency can be disconcerting on voice calls, and it can prevent users from enjoying some latency-sensitive services such as online gaming.

Atmospheric conditions affect both wireless and satellite services, but the problem may be worse for satellite because signals must travel through the entire atmosphere on both the uplink and downlink. Many customers have experienced degradation of their satellite video signals during periods of fog, rain, and snow, although modern satellites can compensate for regional weather patterns by reassigning spectrum and slowing transmission rates.

Vermont has already decided that satellite service is not a viable solution for reaching unserved areas, and thus satellite is not an option for providing universal service.[190] Because of this decision, we do not offer a recommendation here.

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[188] See FCC, *2013 Measuring Broadband America February Report: A Report on Consumer Wireline Broadband Performance in the U.S.*, p. 7.

[189] Other latency delays may occur as the satellite and the ground equipment clear a communications path. The necessary signaling between the set-top box and the satellite controller, to request assignment of a communication channel, can increase latency to a full second. The average latency found in FCC surveys for terrestrial technologies is less than 0.07 seconds. FCC, *2013 Measuring Broadband America February Report: A Report on Consumer Wireline Broadband Performance in the U.S.*, pp. 13-14.

[190] Vermont Department of Public Service, *Vermont Telecommunications Plan 2011,* at 6.

E. Telephone Service and Cable Service

Another key policy question is whether it would be an acceptable outcome that the only landline telecommunications service available in some areas will be provided by the local cable television provider.

Cable television providers have been providing Internet service for more than a decade, and they began offering voice services in Vermont in approximately 2008. Cable's stand-alone prices are generally not the lowest listed in Appendix A, but these companies typically offer discounts when voice or data are combined with video.[191]

Cable-based voice systems generally offer good service quality for both voice and data. Customers generally get fast and reliable Internet connections over cable's coaxial wiring systems, often at speeds considerably faster than the ILEC's DSL service. The cable provider's voice service quality may be nearly indistinguishable from the ILEC's.

The services offered by cable companies can differ in some ways from services offered by telephone companies.

- Cable companies sometimes require their voice customers to first subscribe to video programming. Comcast does offer a stand-alone voice product.

- Cable service can be generally less reliable during a commercial power failure because the cable modem at the customer's premises requires grid power.
  - Many cable modems have a capability for battery backup, but not all cable companies provide battery backup at company expense. Charter, for example, charges extra for battery backup.[192] When customers are required to pay for battery backup, only a small percentage of customers typically will pay the extra charge.
  - Even with battery backup, a cable modem's operating time is limited. A grid failure of four hours or more can exceed the effective life of a cable modem battery.[193]

- Cable service can handle emergency response issues differently. For example, Reverse 911 may not work with some providers.[194]

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[191] Appendix A illustrates Comcast's Vermont rates for four typical service levels.

[192] Gabel and Burns, above, at 18; see also http://www.myaccount.charter.com/customers/support.aspx?supportarticleid=1351#PurchasingBatteryBackup.

[193] Gabel and Burns, above, at 18.

[194] Reverse 911 is a system that places warning calls to subscribers in the event of an emergency such as a flood or fire.

- Only telephone companies are subject to the PSB's Continuous Emergency Access (CEA) rules. This rule requires telephone companies to provide left-in dial tone to otherwise disconnected telephones, thereby allowing anyone to use an otherwise disconnected telephone to reach emergency services.[195]

To provide a basis for discussion, we suggest that Vermont should allow either a telephone company or a cable television company to be eligible for support, provided the designee is willing to undertake COLR obligations in specified geographically mixed zones. Those mixed zones should include a reasonable share of low-density areas, not merely areas where cable companies have already built facilities.

Consistent with our recommendation above that support go only to one provider, this means that the ILEC would not be eligible for support in any area where a cable television provider has been designated.

Vermont should decide whether both ILECs and cable television companies will be eligible for support, provided they accept appropriate universal service obligations in geographically mixed zones.

While this issue is controversial, it may have little real significance. Cable television companies have generally not built facilities into the most distant and costly portions of rural areas. Therefore, it is unlikely that a cable television company would accept an obligation to extend its facilities to serve large zones that include very rural neighborhoods and roads.[196]

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[195] See PSB Rule 7.102.

[196] If the statute were to declare that only telephone companies could receive support, it is highly likely that VUSF service areas would consist of aggregations of existing telephone exchange areas. By making cable television providers eligible for support, however, Vermont would have to allow for the possibility of other kinds of service areas. A cable company might, for example, ask for designation of a village or hamlet area embedded within a larger telephone exchange.

Designating service areas is a traditional function of the PSB. The statute should specify standards that allow the deciding body to promote the general good. At minimum, the PSB would need to analyze external effects, including the effect on the supported carrier that serves the remainder of the telephone exchange. If the total support cost in both areas would increase, the proposed smaller study area should be denied.

F. Municipal Telecommunications Companies

Municipal utility service has a long history in Vermont. Several Vermont communities have municipal electric companies. Burlington has a city telecommunications company that has installed a fiber-to-the-home network in a large part of that city.

Competition from municipal systems can spur investment by incumbent utilities. In other countries, municipal system investments have spurred general network modernization by incumbent utilities that serve other areas.[197]

Municipal systems can also create secondary harmful effects. To the municipality, the inherent advantage of a municipal system is low average cost. But these are the same low-cost customers who often make the greatest contributions to the common costs of the local ILEC. ILECs therefore tend to view municipal competition as a way to cherry pick their most desirable customers, leaving the local ILEC with less revenue and higher average costs. Given these external effects, the decision to charter a municipal telecommunications utility can generate increased claims for VUSF support in areas outside the municipality.[198]

Current Vermont law acknowledges the possibility of municipal communication systems, and it imposes some limits. Municipal telecommunications systems can issue only revenue-backed bonds, and they must ensure that any telecommunications operating losses are not borne by the municipality's taxpayers.[199]

Before the Vermont Legislature defines a support mechanism for privately owned carriers, it should decide whether it wishes to charter any new municipal systems. We do not recommend for or against any such new charters, only that the question be decided before undertaking to calculate USF support to existing investor-owned utilities.[200]

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[197] In the Netherlands, for example, municipal investment spurred considerable private investment in broadband. The municipal entity, however, provided only pipeline service to other carriers and did not establish direct relationships with retail customers.

[198] A second risk is that municipalities may try to use city funds or municipal electric funds to subsidize losses in their new telecommunications operations.

[199] 24 V.S.A. § 1913(c), (e).

[200] Legislatures in other states have considered bills that would *prohibit* municipal telecommunications systems. Bills have been introduced or passed in Georgia, North Carolina, and South Carolina. The FCC's former chairman opposed these laws, saying, "If a community can't gain access to broadband services that meet its needs, then it should be able to serve its own residents directly. Proposals that would tie the hands of innovative communities that want to build their own high-speed networks will slow progress to our nation's broadband goals and will hurt economic development and job creation in those areas." Lynn Stanton, "Genachowski Opposes State Bans on Muni Broadband Networks," *TR Daily,* Feb. 15, 2013.

If the Vermont Legislature will consider chartering any new municipal telecommunications systems, it should make that decision before defining a support mechanism for investor-owned carriers.

G. "Targeting" - Adjusting Support for Competitive Areas

The FCC and some other states with cost-based support systems have sought to target high-cost support to high-cost areas. This means support is reduced or eliminated in areas with low costs, established competition, or both.

The theory of targeting is that in urban areas with low cost or where a competitor fully provides the essential universal services, COLR service from the ILEC is not essential, and therefore no support is needed. The motive for targeting is largely financial, to reduce the overall budget for high-cost support.

The targeting debate has generated its own parlance. Noncompetitive areas are typically at the edges of a telephone exchange. In USF parlance these outlying areas are called "donuts." Conversely, the low-cost or competitive areas near the central office are often called "donut holes."

Support can be targeted through a use limitation, although the effects are likely to be minimal. Under this method, the supported provider must certify periodically that it has actually spent all support funds properly, and only in targeted areas.[201] To implement a use requirement, the supported carrier must trace the dollars in its revenue stream, from their source through their use. Dollar tracing is often largely pointless because companies generally pool all revenues into their treasuries.[202] So long as a carrier continues to spend more money in eligible areas than it receives from the FCC, a use limitation is unlikely to be violated.[203]

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[201] Taking this path, the FCC has announced an intention to condition all future support on the recipient "not spending the funds to serve customers in areas already served by an unsubsidized competitor." *USF/ICC Transformation Order* ¶¶ 103, 149.

[202] The FCC has made its own use limitation even more complex by acknowledging that providers can properly use support dollars in donut-hole areas for facilities that service the outlying donut areas. *Id.*, note 238.

[203] For many years, carriers receiving universal service support have routinely certified annually that every dollar of federal support they receive has been used for the purposes intended. It would not be much more difficult for them to certify that they have also done so in certain areas where costs are highest and where competitors are absent.

Targeting can also be accomplished by reducing support for donut holes, while still providing sufficient support for the donut.[204] To accomplish this kind of targeting, the state would have to map the donut holes, and it would have to adjust support as appropriate. Both tasks are difficult.

The boundary of a competitive donut hole is usually complex because competitive service areas are not well defined. Cable networks often terminate their cable runs in rural areas at an otherwise unremarkable utility pole. Wireless is similar. As one drives a country road, wireless signals can come and go.

The task of adjusting support is also daunting. To support only the donut, one must produce a cost estimate for the network that would serve only that donut. But that network is, by definition, hypothetical, and probably would never be built.

Adjusting support to exclude targeted donut holes can also lead to surprising results.

- The hypothetical network serving only the donut would have longer loops and might lose some efficiencies of scale because it serves fewer customers. The total cost to serve only the donut would be only slightly lower than the cost of serving the entire area. The average cost (per location served) would almost certainly be higher than for the entire area.

- Excluding the donut hole would eliminate revenue from many customers. These are precisely the customers who often make a net contribution to an ILEC's common costs. In more common terminology, they produce a surplus.[205]

In sum, excluding the donut hole can increase average cost and reduce contributions to common cost. Therefore the surprising result is that excluding a donut hole from a support calculation can *increase* the need for support. In economic terms, the net effect would be that explicit USF support would have to replace what previously was an implicit contribution from donut-hole customers.

A variant of the targeting approach is to define the donut hole as an area no smaller than an entire exchange. In other words, support would be denied to any whole exchange that is deemed competitive. This larger-scale targeting could decrease demands on the VUSF budget, although the likely effect will be small. Any exchange area with ubiquitous competition is unlikely to be an area that generates support in any case.

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[204] This approach presupposes that Vermont wishes to adopt a cost-based or business-model-based support mechanism, a matter discussed below. The FCC has also adopted this targeting approach in concept. *USF/ICC Transformation Order* ¶ 281.

[205] Volume II of this report demonstrated that in areas where ILECs face cable competition, their take rate and revenues both have declined.

If Vermont adopts a cost-based support mechanism,[206] We recommend that Vermont disregard the presence of competitors in donut holes. In the alternative, Vermont might establish an administrative procedure by which the PSB could exclude particular donut holes from consideration in the support calculations. The administrative procedure should require examination of whether a competing provider currently serves the entire area and whether the state has sufficient legal authority to require continued provision of the essential service. If the petition is granted, the supported provider's annual support calculation would be adjusted for both the costs and revenues generated in the excluded donut hole.

If Vermont adopts a cost-based support mechanism, it should either disregard the presence of competitors in donut holes or it should authorize the PSB to declare the boundaries of donut holes and to adjust both cost estimates and revenue expectations for those competitive areas.

H. Public and Private Capital

In recent years, Vermont state government and the federal government have made direct grants of public funds for capital investment. These included multiple recent federal and state grants to facilitate construction of wireless broadband facilities.[207] Some of the money went to ILECs or their affiliates.

Capital grants from public funds offer distinct advantages. They create a perception of progress and give both grantee companies and public officials an opportunity to publicize their initiatives. Capital grants also bypass the need to raise private capital. Carriers can proceed quickly from the grant award ceremony to new construction, and market expectations are relatively unimportant.

Ubiquitous networks can be difficult to achieve through capital grants. Grantees sometimes cannot be found to serve the most remote areas, even using public capital, and holes can persist in service coverage maps. Public announcement of grants often recite the details of where service will soon be provided, but these announcements seldom discuss the areas left behind.

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[206] See section V.C. below.

[207] We noted above several grants that have been made recently, primarily to wireless recipients, in order to promote broadband dissemination.

Performance conditions attached to capital grants can be difficult to enforce. Once a grant has been awarded and spent, it can be difficult to enforce the grantee's original promises about coverage or service quality.

Historically, ILECs in Vermont and elsewhere have built their networks mostly with private capital.[208] To make that capital available from the markets, the PSB historically has regulated rates in a way that gave carriers an opportunity to earn a reasonable return on prudent net investment. The market's expectation that utilities could earn that return was essential to raising that capital.

Leverage is the great advantage of private capital. A dollar of support predictably delivered every year can generate many dollars of private capital investment. But that private capital will only be available if the telecommunications carrier can make a credible argument before capital markets that it will be able to repay the loan and produce dividends on equity investment.

If an ILEC faces a series of financial losses, private capital will not be available unless the ILEC can show that the state or the FCC has made a continuing commitment to provide financial support over a reasonable period of capital recovery.[209] The PSB has routinely created such long-term capital recovery expectations in the past, but the context has changed. The issue here is not what rates customers should pay but how much support the state should commit over a long term. This suggests that the state should enact some kind of administrative system that makes more credible the promise of long-term support for long-term investments.

There is also the question about how best to mix these two systems, public capital and private capital. If they are not carefully coordinated, support could be excessive and could lead to excess profits. At minimum, a cost-of-capital subsidy would need to take account of past grants of capital from public funds. We suggest that if Vermont does create a VUSF cost-of-capital subsidy, it should treat past capital contributions from public sources as reducing the need for current support.

In traditional ratemaking practice, a capital contribution from public funds[210] reduces the net capital upon which the utility generates a return for shareholders. So, if a utility gets a capital grant of $1 million, its cost of capital generally declines by something like $0.2 or $0.3 million per year.[211] Similarly, if a new VUSF high-cost support mechanism is created that covers the

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[208] Private capital was augmented by federally guaranteed loan and grant programs, especially in areas served by electric municipal and cooperative utilities and by federal loans from the Rural Utilities Service (originally the Rural Electrification Administration) to small telephone companies.

[209] For example, if the state wants private capital to build telecommunications facilities with an average life of 20 years, the public subsidy must be generally understood as likely to continue for 20 years.

[210] Customer-contributed capital from line extension charges is treated similarly in regulatory practice.

[211] This is a rough rule of thumb that accounts for both return on capital and income taxes.

cost of capital, it would reduce support payments by something like 20% of the capital that was derived from sources other than shareholders.[212]

Vermont should decide whether to provide support for some of the costs of privately acquired capital, and if so, how to adjust support for past contributions of public capital.

I. Rate Standards

We suggested above that universal service should make rates affordable. We also suggested that the fund would be sufficient and effective if it maintains service availability. Each goal implies a standard for the revenue that supported carriers should generate from subscribers. We recommend that Vermont establish a series of rate benchmarks for the most common sets of services typically purchased by telecommunications consumers. Rate standards could be used in two ways:

- If Vermont establishes a customer credit mechanism, the standard could become the target net rate.
- If Vermont establishes a cost-based support mechanism, the standard:
  - Could be used to calculate revenue of supported carriers, in lieu of actual revenue, and
  - Could be imposed as maximum rates allowable for that service to be charged by any supported carrier.

In general, we suggest that rate standards should have a defined relationship to typical or average rates in the rest of the country. Such a VUSF support mechanism could produce support that is sufficient to achieve affordable rates, while also creating a yardstick to determine whether rural rates are reasonably comparable to urban rates.[213] The rate standard for rural areas need not be equal to the national average. Instead, the target rate could be some increment above that average, such as 10% or 25%.

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[212] The federal government's activities complicate designing the niche into which state USF policy can drop. The FCC does not offer any useful guidance on how best to complement these many federal programs.

[213] See 47 U.S.C. § 254(b)(3).

Rate standards powerfully affect support budgets. A higher rate standard for consumer payments increases the burden on rural customers and reduces the burden on the VUSF budget. Conversely, a low rate standard reduces rates for rural customers but requires more VUSF funding, which would place greater demands on all contributors to the VUSF. Because of this strong relationship between rate standards and budgets, Vermont may want to examine several scenarios, looking at the budgetary consequences of various rate standards.

Vermont should establish a set of standard rates for specified voice and broadband service bundles. These standards will powerfully affect the size of the VUSF budget.

National average rate data should be used carefully in setting revenue expectations, because national average rates currently are changing for reasons unrelated to affordability.[214] In some states local rates have increased substantially after enactment of state laws that deregulated rates. Notable examples are AT&T rates in California and Texas.[215] In addition, some low-rate carriers have increased their rates to avoid a new FCC-authorized support penalty.[216] Finally, millions of customers are paying a new FCC-authorized ARC charge each month. We expect the national average rate will soon be approximately $18.00.

In order to initiate the financial discussion with a specific proposal, we suggest that Vermont establish distinct standard rate targets for the following services.

1. Basic telephone service (dial tone), including toll interconnection but without any included right to make free toll calls.

2. Voice service that includes basic telephone (dial tone) and unlimited toll calling in the U.S.

3. Broadband service that meets Vermont's minimum requirements for download and upload speeds.[217]

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[214] As of October 2007, the national average flat-rated service rate was $15.62, plus $10.00 of add-on charges, for a total monthly charge of $25.62. FCC, *Reference Book of Rates, Price Indices, and Household Expenditures for Telephone Service, 2008*, Table 1.1: Residential Rates for Local Telephone Service in Urban Areas (as of October 15, 2007).

[215] See note 111 above.

[216] See *USF/ICC Transformation Order* ¶ 239.

[217] When offered by telephone companies, this service is sometimes called "naked DSL" because there is no voice component.

4. Double-play broadband and voice service, including toll.

J. Deaveraging Rates

Rates differ among different ILECs, but none charges a higher rate within its own rural areas than its own urban areas. This means that each ILEC averages its costs and rates. One USF strategy is to allow carriers to deaverage ILEC rates. ILECs would charge higher rates in rural high-cost areas and lower rates in urban or competitive areas.[218] Deaveraging generally reduces the need for support but increases the burden on rural customers.

Deaveraging retail rates allows carriers to remain more competitive in areas where they face competitive challenges. Lower urban rates can allow ILECs to retain more customers in those areas.

Deaveraging is an example of Ramsey pricing. Some economists have argued that Ramsey pricing promotes overall economic welfare better than uniform pricing.[219] Ramsey pricing has not been widely adopted by ILECs in Vermont or in elsewhere.

The disadvantage of deaveraging is that it could produce unreasonably high rates in some parts of the state. As a result, telecommunications service might become unaffordable, and there could be harm to economic development of rural areas. Deaveraging could also be technically challenging.[220] Finally, deaveraging and can induce rural customers to "cut the cord" and take wireless-only service or to switch to cable modem service. This could precipitate a death spiral for the ILEC.

We recommend that Vermont provisionally refrain from authorizing rate deaveraging. Later, after more detailed analysis, deaveraging may prove a necessary, if distasteful, option to providing sufficient support without exceeding budgetary goals.

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[218] New England Telephone/NYNEX/Verizon at one time charged customers more if they were served by long loops. Verizon imposed an added mileage charge for customers who were located outside of a base zone surrounding every central office. That mileage charge was dropped several years ago.

[219] Under Ramsey pricing, for any monopoly, the price markup to any customer group should be inverse to the price elasticity of demand: the more elastic demand for the product, the smaller the price markup. Ramsey pricing is controversial in the regulatory community, in part because it is often seen as improper price discrimination. This is also the strategy of a profit-maximizing company that can price discriminate between markets. Allowing such a strategy could diminish welfare by harming competition. Moreover, in a multiproduct environment, the proper application of Ramsey pricing may be to decrease the price of basic service. See Jean Tirole, *Theory of Industrial Organization* (Cambridge, MA: MIT Press, 1988), p. 70.

[220] FairPoint's regulatory plan with the PSB currently prohibits de-averaging. Fairpoint has said that deaveraging would complicate advertising and billing systems.

Vermont should provisionally refrain from authorizing rate deaveraging in rural areas but use this option if necessary to meet budgetary goals.

K. Options for the Contribution Base

Universal service was conceived in 1994 as a program that expanded the public telephone network and was supported by that same network. But today broadband is also an essential service. We recommended above that Vermont support broadband in high-cost areas. But the two networks are largely the same and are becoming more so. ILEC networks increasingly are becoming private (non-Internet) IP networks. And these networks increasingly support both voice and broadband services.

We recommend that Vermont consider enlarging the contribution base to include retail broadband service. This will increase the symmetry between those who benefit from VUSF support and those who contribute that support, thereby restoring the fiscal balance achieved in the original 1994 statute. The change would also reduce the risk that voice customers will be burdened to subsidize broadband facilities that they do not use.

There is some litigation risk in this change, but we believe it is within the authority of the Vermont Legislature.[221] Further, it is consistent with a recent recommendation from the Federal-State Joint Board on Universal Service.[222]

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[221] Vermont is a tax state, meaning that it uses the state's taxing authority, rather than delegated authority under the Telecommunications Act of 1996, as the basis for imposing USF surcharges. This allows Vermont to apply its VUSF surcharge to both intrastate and interstate retail voice services. See *Goldberg v. Sweet*, 488 U.S. 252 (1989). Also, the Internet Tax Freedom Act explicitly allows certain state universal service funds to impose otherwise prohibited taxes on Internet services. *Internet Tax Freedom Act* (printed in U.S. Code following 47 U.S.C. § 151) § 1107(a).

[222] In 2011, the Federal-State Joint Board on Universal Service filed comments with the FCC supporting an expansion of the federal contribution base to include all broadband services such as DSL, cable modems, and wireless broadband. The Joint Board recommended inclusion of ISP service, which is traditionally bundled with those broadband services, but did not recommend a surcharge on pure content delivered by non-telecommunications carriers. *Connect America Fund*, WC Docket No. 10-90, Comments by State Members of the Federal State Joint Board on Universal Service, filed May 2, 2011, p. 119. Vermont Public Service Board Member John Burke was a member of that board.

Vermont should consider enlarging the contribution base to include retail broadband service, thereby restoring the symmetry between contributing services and supported facilities.

V. Support Mechanisms for Incumbent Carriers

We have been asked to "propose mechanisms to support universal service and rural economic development while securing the benefits of telecommunications competition for Vermont households and businesses." This section reviews the three principal options for supporting incumbent carriers. Section VI below discusses options relating to support for competitive carriers.

A. Option 1 – Customer Credits or Vouchers

1. Background

The Vermont statute chartering this study requires consideration of the following option:

> [E]stablishing a maximum price for basic telecommunications service, beyond which customers would have access, without regard to income, to credits or vouchers negotiable for local exchange service from a local exchange provider or competitive access provider.

Such a voucher system is a simple and direct mechanism. As an example, suppose Vermont were to establish a rate benchmark of $50 for voice service. Customer Jones takes voice service from an ILEC that charges $75 per month. Under the voucher system, Jones would receive an explicit bill credit of $25. Now suppose customer Smith is served by another carrier that imposes a gross bill of $90. Smith would receive a credit of $40. Both Jones and Smith would have net bills of $50, an amount equal to the statewide benchmark. Later, the VUSF high-cost fund would reimburse Jones's carrier for the $25 and Smith's carrier for the $40 customer credits.

In 1996 the Vermont Public Service Board issued a report to the Legislature regarding universal service. In that report, the Board recommended that the Legislature authorize a high-cost voucher mechanism.[223]

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[223] Under legislative direction, the Public Service Board would have set standards and rate thresholds for service in rural areas. When and if rates exceeded those thresholds, the Board would have approved high-cost program expenditures, and the Board would have adjusted the VUSF surcharge rate to generate

2. Evaluating the Option

A voucher system makes program benefits visible to customers. Rather than having the support invisibly absorbed by the telephone company, the support is apparent on customer bills. In this way, both the benefit and the burden of the USF program are equally visible. The interested customer in a high-cost area sees not only the VUSF surcharge but also the credit that reduces the bill. The visibility of the benefit can increase popular support for the program.

The arithmetic of a voucher system is also simple. Carriers could quickly calculate the amount of a customer's credit each month. The VUSF administrator could easily reimburse the carrier for credits that have actually and properly been granted to customers. Audits would be relatively simple.

Vouchers do have a downside, however. They create risks of inefficiency, ineffectiveness, overpayment, and complexity.

The most serious risk is inefficiency. A voucher mechanism assumes that rates are fixed, and the voucher credit is calculated from the rate. In other words, vouchers assume that rates are determined independently of the credit amount. If rates are dependent on the voucher, a vicious cycle can arise in which carriers can raise gross rates, hold net bills to customers constant, and increase claims for VUSF support.[224] This would make the voucher program inefficient at promoting universal service. In our opinion, any such system would quickly become financially unsustainable.

Rate independence can be achieved in two ways. First, rates might be regulated, either by the Public Service Board or another body, based on cost. But Vermont's current rate regulation system does not satisfy this prerequisite. Broadband service rates are preemptively deregulated by the FCC, and voice service is lightly regulated, much more lightly than when the PSB recommended vouchers in 1996. As discussed above in section I.E.2, Vermont has separate regulatory systems for FairPoint and for the other ILECs, but neither system can impose enough limitations on rates to make them independent of voucher payments.

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sufficient revenue. The Board would also have ensured that benefits followed customers who would have been free to select from among competitive providers. Vermont Public Service Board, *Universal Service in a Competitive Era*, 1996.

[224] For example, suppose Carrier A today charges $80 for a double-play bundle and the VUSF sets a final net bill of $60. A customer bill would show the $80 gross charge, a VUSF credit of $20, and a net bill of $60. The VUSF would later reimburse A for the $20 credit paid to the customer.

But now suppose Carrier A raises its gross rate to $100. The carrier will continue collecting $60 from the customer, but its VUSF payment will be $40. In short, Carrier A will have raised its rate, and the VUSF will provide *all* the incremental revenue to A. The credit thus will increase Carrier A's profit but will not provide any added consumer benefit.

Rate independence can also arise from market forces, but a voucher mechanism itself changes how those market forces operate. With a voucher in place, a carrier can raise its gross rates without affecting customers. The voucher thus moves the incremental burden from a rate increase from the retail customer to the VUSF.[225] By eliminating that incremental customer cost, the voucher system eliminates most or all of any existing market-based constraint.

In sum, it appears likely that if the VUSF offered a customer voucher or credit, neither regulatory forces nor market forces would constrain future rate increases. Because a voucher system automatically increases support when rates rise, the mechanism would not efficiently allocate support and would quickly become financially unsustainable over time.

Voucher systems risk ineffectiveness because they do not ensure the support is sufficient to ensure that the carrier can continue providing service. Voucher systems reimburse carriers only on a per-customer basis. Even with such a system in place, an ILEC that is losing customers to a strong competitor might not remain economically viable.

A voucher plan also risks overpayment if it pays benefits to multiple providers in a single area. One charm of a voucher program is that the state gets to be agnostic about which carriers receive funding. Vouchers are given to all carriers that meet minimal qualifications. The disadvantage is that several providers will generally have a higher total cost of providing service than a single network. Not only do multi-provider voucher systems subsidize the costs of multiple networks, but they do so in high-cost areas where a single network is prohibitively expensive. The question of payments to multiple providers is considered below in Section VI.B. Overpayment is particularly troublesome if it is combined with ineffectiveness.

Finally, voucher plans have not proven simple to administer. Wyoming provides a case study. In 1995 Wyoming adopted a bill credit system for "essential services," which it defined as local voice service but not including toll. The Wyoming Public Service Commission was tasked to periodically adjust the rate threshold based on shifts in the statewide average rate.[226] Wyoming's system has become difficult to administer because key statutory terms, such as the average rate for essential service, have become increasingly synthetic. The Wyoming Commission has had to invent creative techniques to allow continued use of this largely obsolete statutory term.[227] Furthermore, different Wyoming carriers calculate and display the credit in

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[225] Another option to impose pricing restraint would be to have set the voucher at something less than 100% of the difference between the gross rate and the rate target. This would leave customers with a financial interest in low rates and would thereby preserve at least a share of whatever market restraint now exists. Unfortunately, this strategy would leave customers in very high-cost areas without any guarantee of a maximum rate, and it would allow net rates in areas with the very highest gross rates to be higher than net rates in other areas.

[226] Wyoming tries to ensure that consumers pay no more than 130% of the state average rate for "essential service."

[227] Most Wyoming customers do not buy only essential service. Even worse, some Wyoming carriers do not offer essential service on a stand-alone basis.

different ways. Wyoming is currently reviewing whether to revise its credit mechanism and USF system.

Wyoming has not yet faced the more difficult task of designing a customer credit mechanism that would apply to a range of service packages. If Vermont adopted a universal service voucher mechanism, it would likely need separate benchmarks for different kinds of product bundles purchased in large quantities by customers.

Business customers also complicate voucher mechanisms. The simplest option is to offer credits only to residential customers,[228] but this leaves business rates high and creates economic development risks. A business facing high telecommunications costs in a rural area has an incentive to relocate the business to an urban area in Vermont or even to another state.

In sum, an explicit consumer credit appears unworkable without some mechanism that makes gross rates independent of the credit itself. At minimum, the articulation with PSB price-cap ratemaking should be clarified. Moreover, a credit mechanism risks ineffectiveness and overpayments, and it would be moderately complex to administer.

An explicit consumer credit appears unworkable without some assurance that gross rates are set independently of the credit itself. A voucher plan might be ineffective at ensuring continued service, might provide excessive support to multiple providers, and would be moderately complex to administer.

B. Option 2 – Broadening Lifeline

1. Background

The Vermont statute chartering this study requires consideration of broadening eligibility for the Lifeline program. The Lifeline program promotes increased telephone subscribership by providing low-income households with discounts on the monthly cost of telephone service. The discounts are provided as credits on consumer bills. In a nutshell, Lifeline can be thought of as a voucher program that applies only to low-income households.

[228] The distinction between a residence and a business is often difficult to police, particularly when many residences contain home occupations.

The amount of the Lifeline benefit to participating Vermont customers is set by state statute.[229] Toll (long-distance) calling is not covered. Lifeline reduces the net monthly Vermont telephone bill for local service by about $13.50. In May of 2013, 17,401 subscribers were enrolled in the Vermont Lifeline program.

The FCC and the VUSF each subsidize a portion of the benefits that carriers provide to eligible Lifeline customers. In 2011 the average federal benefit was $9.87 per subscriber per month, for a total of $2.3 million paid to Vermont carriers throughout the year.[230]

The VUSF also contributes support to reimburse each carrier's Lifeline credits. Between the federal and VUSF support amounts, carriers are made whole by reimbursing them retroactively for all the credits set by state law. In fiscal year 2011, VUSF contributed an average of $3.58 per Lifeline customer per month.

Previously, the FCC offered matching tiered federal support, with greater support awarded to states that offered greater benefits.[231] The current Vermont statutory benefit was designed with that matching feature in mind. In 2012, the FCC simplified its rules, establishing a uniform federal support level of $9.25 per subscriber per month, thereby slightly reducing federal support to most Vermont carriers.[232] Since the level of customer benefit remained constant under Vermont law, the average monthly VUSF support cost per customer increased.[233]

Vermont's Lifeline eligibility rules generously provide two entry paths. The first is through public assistance and covers telephone subscribers who meet the means tests for eligibility for public assistance from the Department for Children and Families or actually

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[229] See 30 V.S.A. § 218(c). The total Vermont benefit is equal to the amount of the federal subscriber line charge, plus an amount equal to the larger of: (A) 50 percent of the monthly basic service charge, including 50 percent of all mileage charges and, if the board so authorizes, 50 percent of the usage cost arising from a fixed amount of monthly local usage; and (B) $7.00 per month. The benefit cannot exceed the monthly basic service charge, including any standard usage and mileage charges. 30 V.S.A. § 218(c).

[230] The national average reimbursement was $9.25. FCC, *Universal Service Monitoring Report, 2012* (data through October, 2012), Table 2.4.

[231] Federal rules established four tiers of support, with varying federal participation. Vermont's Lifeline statute was tailored to take advantage of this incentive structure. For example, where a state offered an additional benefit of $3.50, the FCC matched 50% of that additional state cost.

[232] 47 C.F.R. § 54.403(a)(1). FCC, *Report and Order and Further Notice of Proposed Rulemaking*, FCC 12-11, rel. Feb. 6, 2012, para. 58.

[233] In May of 2013, the average VUSF Lifeline cost per customer had risen to $4.15.

receive assistance from that department.[234] The second path is through the Department of Taxes and covers subscribers whose incomes are less than 150% of the federal poverty level.[235]

2. Evaluating the Option

Broadening Lifeline eligibility and benefits might be administratively simple, depending on how much is changed. The Lifeline credit mechanism is already in place. Both the enrollment and the amount of the benefit could be increased with relatively little additional work by the VUSF administrator or state agencies.

Lifeline also targets support to poor households. Other mechanisms for high-cost support are criticized because they lower telephone rates generally, for rich and poor customers alike. Lifeline, however, has a means test that ensures that VUSF funds are focused most efficiently on residential households that need financial assistance.

Expanding Lifeline also creates challenges. The program would need to be redesigned to include broadband services, and that complicates administration. For example, an expanded Lifeline program should provide varying levels of benefits to customers who subscribe to different kinds of service bundles such as voice, voice with Internet, and so on.

Carrier eligibility is also an issue. The FCC currently offers a relaxed set of requirements for carriers that seek federal USF support only for Lifeline benefits. These Lifeline-only carriers need not make any sort of promise to provide facilities in a manner similar to a COLR. Vermont would probably want to narrow the set of carriers currently eligible for a Lifeline program, so as to ensure that the VUSF support is used effectively to maintain essential facilities.

By offering benefits to a broad class of competitors, an expanded Lifeline mechanism could be viewed as more competitively neutral than some other USF mechanisms. By the same token, VUSF funding might be distributed to multiple carriers in a single area. As with vouchers, this practice might produce overpayments without effectively ensuring continued service.

We suggested above that consistent economic development is a legitimate goal of high-cost USF programs. A Lifeline mechanism does not address this goal. First, it provides benefits only to low-income residential households but not to business customers. Those business customers might have to pay high rates for their voice and broadband services. As was also true for vouchers, a Lifeline expansion mechanism therefore would not ameliorate the pressure for business customers to avoid rural areas.

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[234] 30 V.S.A. § 218(c)(2).

[235] 30 V.S.A. § 218(c)(3) ("A person shall be eligible whose modified adjusted gross income . . . was less than 150 percent of the official poverty line established by the federal Department of Health and Human Services for a family of two published as of October 1 of the preceding taxable year.") Persons 65 years of age and older are eligible at a slightly higher income multiple, 175%.

A Lifeline mechanism may not create useful incentives. If a VUSF program is to keep high-cost rural areas economically competitive, it must induce carriers to invest. That means VUSF support must be predictable and sufficient. Lifeline, however, depends on consumer participation and provides no protection against subscriber loss. Mechanisms other than Lifeline are more likely to produce predictable and sufficient support and therefore to induce carriers to make sufficient investments in new network facilities.

Lifeline often seems intrusive to customers. Most applicants demonstrate eligibility by disclosing their income. This can create a social stigma that prevents full participation. Some eligible customers ignore Lifeline because they disdain benefits that are targeted to low-income households.

Eligibility determinations for Lifeline can consume considerable time by provider staff or state employees. If Lifeline were expanded, this administrative burden would increase.

Avoiding waste and abuse has been a national problem for Lifeline. For example, federal rules currently prohibit eligible low-income consumers from receiving more than one Lifeline discount per household. An eligible household may receive a discount on either a wireline or wireless service but not both. Enforcing this limitation can be complex and costly, particularly when multiple providers serve a single area.

Administrative burden on the state is also a concern. If Lifeline is expanded substantially, the burden of certifying initial and continued eligibility will increase. This could affect the budgets of the Vermont agencies currently involved in administering Lifeline.

Like a voucher program, if gross carrier rates are not limited independently, the Lifeline mechanism risks inefficiency by subsidizing carrier profits rather than customer benefits. The risk increases as a higher proportion of Vermont households enroll in Lifeline.

In sum, expanding the Lifeline program would produce a mechanism that is transparent to consumers, but not necessarily a program that is easy to administer if broadband is added to voice as a supported service. Further, Lifeline has a degree of stigma and can be intrusive for customers. It also creates an administrative burden for the state. A Lifeline mechanism may not adequately induce carriers to invest, although it could marginally increase the ability of carriers to raise rates.

An expanded Lifeline program would be difficult to apply to broadband. The mechanism could create intrusive paperwork burdens for customers, may not achieve high participation rates, and may not adequately induce carriers to invest.

C. Option 3 –Business-Model-Based Support to COLRs

The Vermont statute chartering this study requires consideration of the following option:

> [E]stablishing a mechanism to adjust the level of support for higher cost customers over time to reflect legal rights, recover historic costs, and reflect the advantages of improved technology and increased efficiency.

We interpret this statute as directing us to examine the option of providing support based on cost but to keep in mind secondary incentives for efficiency. This section discusses the main elements of a cost-based support mechanism.

Historically, cost-based support mechanisms have amounted to implied bargains between carriers and the government. On the one hand, the government gets to assign duties to each supported carrier, including a prescribed level of service coverage that approximates COLR duties. As consideration, the carrier gets support sufficient to allow it a reasonable opportunity to recover the cost of its network operations and facilities, with USF support as a last resort.

Cost-based support mechanisms historically have been based on a simple calculation: support equals cost minus a number called a "benchmark."[236] This kind of cost-based mechanism continues to be under consideration today at the FCC for new USF programs.[237]

Revenue was always implicit in these older support calculations, as part of the benchmark. Since the purpose of the USF program was to keep the supported carrier in operation with reasonable rates, a supported company had an implied obligation to acquire other revenues at least equal to the benchmark. Any further revenue shortage would be made up from USF funds. In failing to consider actual carrier revenues, the traditional cost-based support mechanism therefore risked allowing supported carriers to recover more or less than 100% of their costs.

For the same reason, a mechanism that makes no explicit consideration of revenue cannot adjust when those revenues change. This kind of support mechanism worked reasonably well when nearly every household had landline telephone or even two lines. But it becomes unworkable when markets are competitive and ILECs no longer have anything like one subscriber per location served. As we showed in Volume II of this report, competition has

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[236] For example, the FCC adopted a program in 2000 that had a benchmark set at 135% of the national average cost, which amounted to about $31.50 per line per month. In effect, companies with costs below $31.50 received no support.

[237] Under the ABC plan submitted by some carriers to the FCC, a cost benchmark would be shifted up or down to align the amount of support provided with the budget. For example, in order to meet a $2.2 billion budget constraint, the ABC plan supports two cost benchmarks, $80 and $256. Support would be provided for census blocks with a cost greater than $80 and less than $256.

greatly affected ILEC revenues in Vermont, particularly in areas with cable competition. Cost-based mechanisms cannot appropriately consider these changed market conditions. By holding all carriers to the same cost benchmark, cost-based mechanisms require all carriers to earn the same revenue per location served. That is not a reasonable expectation when competition varies from one area to another.

Instead, we recommend the use of a business model that explicitly estimates cost and revenue separately. If the goal of Vermont's support system is to ensure that a supported provider can continue offering service indefinitely, then one must abandon the simple cost benchmark approach. Instead, a high-cost support mechanism should focus on the supported carrier's revenue gap, the difference between a reasonable revenue objective and the carrier's reasonable costs.[238] This mechanism would allow the supported provider, given its competitive circumstances, to implement a plausible business plan and to have a reasonable opportunity to obtain private capital and to earn a reasonable profit. Hereafter, we describe this kind of mechanism as business-model-based rather than cost-based.

1. Components of a Business-Model-Based Support Mechanism

A business-model-based support calculation would require the state to undertake three tasks:[239]

1. Estimate each carrier's cost. This could mean actual accounting-based costs, forward-looking costs, or a combination of the two. To fully respond to the 2012 Legislature's request to be informed about the costs of providing service in Vermont, we examined both the embedded and forward-looking costs of Vermont incumbents.

2. Estimate each carrier's revenue. This would replace the benchmark in the traditional support calculation. The calculation would take account of the number of locations in the service area, as well as competitive conditions. It might also include adjustments to maintain desirable incentives, such as minimum rates, minimum take rates, and minimum revenue per unit location.

3. Calculate support as a function of the difference between cost and revenue. The result could be 100% of the difference or a smaller percentage. The calculation

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[238] A revenue gap analysis was an essential element of the FCC's initial broadband notice, *Connect America Fund*, WC Docket No. 10-90, Notice of Inquiry and Notice of Proposed Rulemaking, FCC 10-58, released April 21, 2010. The *USF/ICC Transformation Order*, however, reverted back to a simple cost benchmark.

[239] This three-part process has common elements with traditional rate-of-return regulation. The difference is that rather than solving for retail rates sufficient to meet the carrier's revenue requirement, the business-model-based support process would assume a reasonable retail rate and reasonable retail revenues. It would then solve for a VUSF support amount.

might also include adjustments to maintain the VUSF fund budget or to maintain appropriate carrier incentives.

If Vermont's support system is to ensure that a supported provider can continue offering service, then the provider must have a plausible business plan that creates a reasonable opportunity to earn a profit after paying all its costs, including capital costs. This requires that support be calculated in three steps: measuring and limiting costs, predicting revenues, and calculating support.

a. Measuring and Limiting Costs

"Cost" usually means that a carrier has an opportunity to earn sufficient revenue to cover reasonable operating expenses and to provide a reasonable return on capital (usually net investment). The original method of actually measuring cost was to rely on utility accounting records, or embedded costs.

Inefficiency is the most common criticism of embedded cost support mechanisms. Because all reasonable carrier costs are allowed, carriers can have incentives for waste. Some precautions are needed to minimize that risk. If Vermont adopts a business-model-based support mechanism, we recommend that Vermont also impose some restraints on embedded costs in order to create an incentive for efficient operations.

If Vermont adopts a business-model-based support mechanism, it should impose some restraints on embedded costs.

One method of restraining embedded costs is to use forward-looking costs as a substitute. Forward-looking costs are produced by engineering cost models that estimate the cost of building a new network capable of providing the desired service.[240] The models use as inputs the independently recorded attributes of the service area, such as customer locations and soil and terrain characteristics. The cost model then constructs a virtual network in that area using

[240] In economic terms, forward-looking cost is very similar to what economists call long-term incremental cost. See Volume II, p. 4 for a discussion of forward-looking and embedded costs.

accepted engineering principles. Finally, the model produces an estimated cost based on current materials and labor costs.[241]

The FCC adopted a cost model in 1999, and it is currently working on a replacement model.[242] The older model has problems involving placement of facilities along roads or other recognized rights-of-way[243] and regarding special access. These inaccuracies make the old model unsuitable for use in Vermont.[244] If Vermont does decide to use an engineering cost model, it should acquire a newer version, assuming the cost is not excessive.

A second criticism of embedded costs and revenues is that they are available only at the study-area level. It is not possible to determine embedded costs on a wire center, donut, donut hole, or census block basis. Therefore, if Vermont calculates support after considering events at a scale finer than the exchange, it will need a cost model to perform these cost allocations to smaller geographic units.

Engineering cost models are controversial because they provide the cost of a hypothetical network that could have little relation to the real network used by a COLR provider. This can lead to insufficient or excessive support. Support could be insufficient if the model does not recognize exceptional local variables or regional conditions that increase cost. Conversely, models assume new construction and do not recognize the existence of highly depreciated plant.[245] Where the real network is old and heavily depreciated, the result can be excessive funding.

Engineering models are costly to operate and maintain. One reason is that they require massive quantities of geographic data, much of which needs to be periodically updated. Another reason is that current models are proprietary to private engineering companies and are expensive

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[241] Cost models can allocate network costs to very small geographic areas, which can be useful for calculating support in competitive areas or areas with very high costs or very low costs.

[242] Volume II of this report used a modified version of that model to estimate costs in Vermont.

[243] Engineering cost models also tend to make grand assumptions about costs whenever detailed local data are not available. For example, the FCC's 1999 cost model ignored local differences in the actual arrangements for utility pole cost sharing among electric, cable, and telecommunications utilities. It also ignored regional preferences to place cables in underground trenches or on aerial poles and oversimplified the calculation of how point-to-point services affect the costs of providing service to dial-tone customers.

[244] See Volume II, p. 20.

[245] The FCC is currently considering whether to replace the classic kind of model, which is called a "greenfield" model, with a "brownfield" model. In a greenfield model, all of the plant is presumed new and capable of being located in the least costly locations, with the exception of the central office, which is given its real-world location. In a brownfield model, some existing plant is assumed, and some additional actual locations for that plant are used as inputs. A brownfield model generally produces a lower cost estimate than a greenfield model.

for states to access.[246] States that have used forward-looking models for USF purposes have tended to use a model only once and then recycle the result for many years.

A second method of restraining embedded costs is to use statistical analysis. The FCC records the actual spending patterns of over 500 carriers nationwide. Recently, the FCC used this data in a regression model to identify some companies with extraordinarily high costs. The model predicted a reasonable but high level of spending for each carrier, after considering geographic and demographic factors about the carrier's service area. Carriers whose actual costs exceeded that predicted high cost were capped and now receive reduced federal USF support.

It is possible to use a combination of engineering and regression models. As implemented in Nebraska, this proved to be an efficient way to calculate state USF support. Nebraska acquired a cost model and then through a regression study found that density was closely correlated with cost. In Volume II of this report we found that location density is a reliable predictor of forward-looking cost in Vermont.[247] Therefore, Vermont could safely follow Nebraska's method, using location density as a proxy for cost, based on a one time regression study that correlates location density with forward-looking cost. Other limitations on cost could also be developed using regression methods.

We recommended above that Vermont should impose some restraints on embedded cost. We do not go so far, however, as to recommend ignoring embedded costs entirely. Using embedded cost in the VUSF support calculation creates a strong incentive to invest. Basing support on forward-looking cost might restrain waste, but evidence in many other states suggests that this practice also leads to underinvestment and inadequate maintenance.

If Vermont adopts a business-model-based support mechanism, we recommend a combination method that incorporates elements of both embedded and forward-looking costs. Ideally, this dual approach will create incentives for essential capital and operating expenditures, while restraining any tendency toward waste.

If Vermont adopts a cost-of-service-based support mechanism, it should estimate costs using both embedded and forward-looking methods.

[246] The FCC has been publicly experimenting with a new model but has not made that model available to state USF funds.

[247] Volume II, p. 21. Location density is defined as the number of locations needing service within a service area, divided by the number of square miles in that service area.

Using two kinds of costs sounds dauntingly complex, but that need not be the case. Nebraska uses both density (which is correlated to forward-looking cost) and embedded cost to calculate USF support. The Nebraska fund administrator has used a forward-looking loop cost model to assign a relationship between cost per loop and density. Each year the administrator calculates an initial support amount for each carrier based on the density of that carrier's service area. The initial support is the difference between the support area's cost and a benchmark times the number of households in the support area. After that initial support has been calculated, carriers file annual spending and investment reports. Based on those reports the administrator then estimates the carrier's embedded cost of service and its estimated embedded earned rate-of-return on investment, counting the initial USF support as revenue. If that rate-of-return exceeds a target earnings ceiling, state USF support is accordingly reduced.[248] The companies understand the resulting incentives. As net investment declines, any given level of earnings eventually will become excessive and will lead to reduced state USF support. Nebraska's dual method of measuring cost thus avoids excessive carrier profits while at the same time maintaining administrative simplicity and incentives for continued network investment.[249]

b. Predicting Revenue

A revenue model for a company would sum four estimates:

1. Subscriber revenue. This estimate will depend upon the number of subscribers, which depends on competitive conditions. It also depends on the average revenue obtained from each subscriber, which can be defined by the rate standards discussed above, in Section IV.I.[250]
2. Intercarrier revenue. This estimate will depend on how much traffic the company can reasonably expect of each type and the average revenue obtained from that source. It would include net toll access revenue, net intercarrier compensation revenue, and special access revenue. Much of this information is routinely reported now to state regulators.
3. Federal revenue. This estimate will consist of USF support and net pool settlements revenue, if any. Connect America Fund revenue is a special case discussed below.
4. Nonregulated network revenue. This estimate would include revenue from Internet operations that operate through the same telecommunications network as the USF-supported services.

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[248] Nebraska Public Service Commission, *Annual Report to the Legislature on the Status of the Nebraska Telecommunications Industry*, September 30, 2013.

[249] This mechanism does require an annual filing by supported companies, but many companies consider the filings to be routine.

[250] This revenue would be unseparated in that it would include both interstate and intrastate revenue.

This explicit revenue model in a business-model-based mechanism is the only major change from traditional cost-based support mechanisms. While the revenue model may be an unwelcome complication to some, we believe it is essential in a competitive environment. In the traditional cost-based model, the same benchmark is subtracted from the cost of each carrier, thus assuming each carrier is equally capable of deriving other kinds of revenue, notably subscriber revenue, per location served. For example, the current FCC model assumes that every carrier can get subscriber revenue from 80% of the locations passed.[251] That assumption is not appropriate in the kind of competitive local exchange environment now present in Vermont.

We found in Volume II of our report that important differences exist among Vermont's ten study areas and those difference affect both the number of subscribers and the total subscriber revenue. Some companies have higher or lower residential take rates (ratios of switched lines to locations).[252] Some companies face competition from wireless services, both fixed and mobile. Some companies face competition from independent cable providers. With this much revenue variance, it is no longer realistic to assume a fixed or benchmark level of revenue per location or per line served. Therefore, a revenue model is needed if VUSF support is to have a realistic opportunity to meet universal service goals. Absent a revenue model, any USF mechanism would likely fail to provide sufficient support in any area where the supported carrier faces a high level of competition.

Creating an explicit revenue model is a novel task for a state universal service program. The elements of that model need not be decided in legislation. The task can be delegated, with suitable standards, to an administrative agency. Once that revenue model has been initially defined, it can be routinely administered by the state's Fiscal Agent.

The FCC has a variety of USF support programs, as we discussed in Volume I of this report. At the present time, the support amounts for most of these programs can be predicted with fair precision. The Connect America Fund Phase II (CAF II) program is an important exception.

An estimate of CAF II support currently available suggests that FairPoint's two study areas in Vermont could receive between $7.7 million and $8.8 million per year.[253] This is a

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[251] In June of 2013, the FCC used a benchmark parameter of $52. This was based on average assumed subscriber revenue per month of $65, with 80 percent of the customers taking service. $52 = $65 x 80%. FCC Docket No. 10-90, DA 13-1439, note 7.

[252] This ratio can increase in areas where businesses subscribe to more than one line, and it can decline as competition erodes the number of subscribers.

[253] On June 25, 2013, the FCC published illustrative results showing the two Vermont FairPoint carriers receiving annual CAF II support of between $7,713,205 (using an 8% rate-of-return) and $8,835,838 (using a 9% rate-of-return). *Wireline Competition Bureau Announces Availability of Version 3.1.4 of the Connect America Fund Phase II Cost Model, Illustrative Results, and Updated Methodology Documentation*, WC Docket No. 10-90, DA 13-1439, released June 25, 2013. The August 29 illustrative results for the combined FairPoint carriers were $8,819,124 (using an 8% rate-of-return) and $8,662,714 (using a 9% rate-of-return). *Wireline Competition Bureau Announces Availability of Version 3.1.4 of the*

substantial amount of money, but there are several uncertainties about whether the support will materialize.

- The parameters used to produce the current estimates are critical but uncertain. The FCC intends to offer no support to census blocks with an average cost below a particular benchmark, as predicted by a new computerized cost model. In order to preserve its ability to adjust parameters to meet budget objectives, the FCC has not yet made a commitment to any particular benchmark value.

- The FCC intends to offer no support to remote census blocks that the new model predicts to have very high cost above a second benchmark.[254] The FCC predicts this new remote areas policy will apply to less than 1 percent of the total locations. [255] The FCC has not made a commitment to any particular benchmark value.[256]

- The FCC will not provide support to locations where an unsubsidized provider is currently providing broadband services. For example, if a cable provider is offering Internet data transmission service in a particular census block, then the telephone carrier that serves that census block will not be eligible for CAF II support.[257] It is not yet clear what portions of Vermont will be affected.

- FairPoint may not participate. Participation in the CAF II program is not mandatory,[258] and each carrier will have to weigh the amount of support against the added obligations that come with it. CAF support may not be sufficient to allow FairPoint to build to the 4 Mbps download speed that the FCC requires.

CAF II support could provide substantial support for the Vermont's universal service goals that otherwise would be a burden on the VUSF. To encourage acceptance of such federal support, Vermont should deem all offered federal support to have been accepted. That is, the VUSF should determine federal revenues as though each carrier had accepted all offered forms

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Connect America Fund Phase II Cost Model, Illustrative Results; Seeks Comment on Several Modifications for Non-Contiguous Areas, WC Docket No. 10-90, DA 13-1846, released August 29, 2013.

[254] The FCC sometimes calls this parameter the "alternative technology benchmark." Remote locations may be eligible for support from a separate Remote Fund with a budget of $100 million nationwide. This modest budget suggests that the amount of support to any "remote" individual location in Vermont and to any Vermont company would be relatively small. *USF/ICC Transformation Order* ¶ 126 and ¶168.

[255] FCC Docket No. 10-90, DA 13-1846, note 31.

[256] By using the two-threshold approach, it appears the FCC plans to limit total support for price-cap carriers at $1.8 billion per year.

[257] *USF/ICC Transformation Order*, ¶ 170

[258] *USF/ICC Transformation Order*, ¶¶ 171-173.

of federal high-cost support, including CAF II support.[259] For example, if FairPoint needs $8 million of annual state support without regard to CAF II, but FairPoint is entitled to $7 million annually from the CAF II program, then Vermont would provide FairPoint with $1 million per year, whether or not FairPoint participates in the CAF II program.

This policy would create an incentive for carriers to finance their advanced networks with as much federal funding as possible, and it has several potentially beneficial effects. First, it makes it more likely that the sum of federal and state USF support will be sufficient, despite the severe financial limitations that apply to each, while at the same time ensuring that no more than a sufficient amount of support is available. Second, the policy should maximize rapid broadband deployment in Vermont by making carriers more aggressively seek funding. Third, this policy might allow Vermont to conserve its limited VUSF dollars to serve the so-called "remote areas" where the FCC will not provide any support and where the FCC apparently expects broadband service to be available only by satellite.

If Vermont adopts a business-model-based support mechanism, it should include a revenue model that: sets reasonable expectations for the number of subscribers (reflecting competitive conditions); sets ARPU standards for several popular service bundles; reflects other kinds of revenue; and assumes that all available federal support has been accepted.

c. Calculating Support

Once costs and revenues have been calculated, the simplest possible support calculation would be to set support equal to 100% of the difference. This would effectively provide a business subsidy sufficient to allow the company to meet all costs recognized in the cost model, while still operating effectively enough to meet reasonable revenue expectations.

Support adjustments can be made for other purposes. For example, support could be reduced proportionally for all carriers if support would otherwise exceed the funds available. Similarly, support can be reduced for specific carriers to manage their incentives, such as for failing to meet service availability or service quality goals.

Stating the support calculation as a separate step allows explicit consideration of budgetary objectives. Vermont may need to perform several iterations of the support calculation

[259] An exception would be federal funding that comes with performance obligations on the supported carrier which Vermont does not wish to finance from VUSF. For example, if the FCC offered funding for a carrier to upgrade its network to 1,000 Mbps, and the carrier declined, Vermont should probably not deem that revenue to have been received by the carrier.

before it can meet its budgetary target. To reduce the support budget, the two most obvious adjustments would be to decrease cost by excluding larger areas from support eligibility and to increase revenue by increasing subscriber rate standards.

2. Incentives

We recommended above that a support mechanism should create incentives for carrier efficiency and adequate investment.[260] In pursuing that goal, the most important measure is to adopt balanced restraints on embedded cost recovery, also as discussed above in relation to measuring costs.[261]

In addition, incentives can be managed through the revenue model. For example, an explicit revenue model allows policymakers to influence rates. Some carriers in other states historically have charged very low local monthly rates. If the carrier receives USF support, that support can be seen as subsidizing very low rates. To eliminate this possibility, some states have built in incentives to maintain reasonable minimum and maximum rates. One technique is to apply a minimum rate floor that assumes the carrier is charging at least a reasonable amount to its subscribers.[262]

At the other rate extreme, business-model-based support can also be adjusted to charge no more than an affordable rate. If Vermont wants affordable broadband service, then the USF mechanism can include an incentive that nudges the carrier to maintain an affordable rate. In general, the approach would be to reduce VUSF support when the carrier's rate for a particular bundle is above a prescribed ceiling. One advantage of a business-model-based approach is that it automatically builds in such an incentive. If Vermont uses a revenue model to calculate support, that model can be designed to deduct from cost the larger of either actual revenues or a minimum floor revenue.

A revenue model can also avoid subsidizing management failures or service failures. If a carrier provides poor service and loses customers, USF support might increase to replace the lost subscriber revenues. This risk can be managed by such measures as assuming that each carrier will maintain a minimum take rate within its service territory or that it will generate a minimum amount of revenue per location passed. In this way, the revenue model can ensure that universal service support does not insure carriers against the effects of poor service.

Business-model-based support can also be adjusted to maintain incentives for service quality. For example, support can be decreased if a carrier fails to meet standards for broadband service delivery targets.

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[260] See Section III.D.

[261] See Section V.C.1.

[262] Confusingly, federal USF parlance characterizes this minimum monthly rate as another kind of "benchmark."

3. Evaluating the Option

In our judgment, a business-model-based support mechanism has the best chance to be effective at what we believe should be the VUSF's principal goal, maintaining continued ubiquitous service in all parts of the state. The mechanism is capable of responding to all the principal factors that are likely to affect the ability of a telecommunications provider to continue providing service, including changes in federal support and changes in competitive conditions.

A disadvantage is that the VUSF support would not be transparent to the user. If support is provided to carriers directly, VUSF support might become just another carrier revenue source, and customers might have no idea about the extent to which the VUSF payments that they and others make every month on their telephone bills have an impact on continued service. This disadvantage could be eliminated if the state were to mandate that carriers show both gross (pre-VUSF) and net (post-VUSF) rates on consumer bills.

Another disadvantage is complexity. Many issues arise in designing such a mechanism, and the amount of continuing work could be substantial to ensure that the mechanism continues to accurately track the business conditions in the state's telecommunications markets.

VI. Support for Competitive Carriers

The preceding discussion largely ignored the problem of which kinds of providers will be eligible to receive VUSF high-cost support. Many states have answered this question by simply prescribing in law that only ILECs are eligible to receive state USF support.[263] In contrast, Vermont Lifeline benefits have been distributed to both ILECs and competitors. This section assumes that Vermont is interested in considering the possibility of providing support to competitors.

A subsidized competitor often will have an economic advantage that drives out unsubsidized competitors. In that sense, granting a USF subsidy can effectively pick a winner in a competitive contest because it gives the recipient an economic boost. A key question for VUSF high-cost support is whether that support should pick a winner or should go to more than one provider per location. One possible answer is that support will be available to a broad class of qualified providers. The other possibility is that there will be one winner who will be fairly selected and who will provide good value to the state.

Three approaches are worth considering. First is the identical support rule, which the FCC historically used for many years but has now abandoned. Second is the competitive bidding, or auctions, approach. Finally, we consider a mechanism by which competitors could challenge the currently eligible carrier for the right to continued support.

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[263] Vermont distributed its onetime high-cost support in 2012 only to ILECs.

A. Franchises and Picking Winners

The desire to avoid picking winners, while understandable, is at odds with the fact that a government picks a winner every time it spends public capital. In the 19th century, the federal government picked winners when it helped Samuel Morse build his telegraph line and funded the Central Pacific Railroad. Today the federal government picks winners when it builds army bases and supports cancer research. Vermont picks winners when it approves highway contracts and appropriates funds for state colleges. Utility regulation is no exception. In the 20th century, the PSB picked a winner every time it approved an electric generation or transmission project under Section 248 of Title 30. Today the Vermont Telecommunications Authority picks a winner every time it makes a grant for broadband support.

Franchising is a related historical concept. A franchise is a particular bundle of rights and duties held by a private entity. Utilities have franchises that require them to expend their own capital to build facilities. A utility also must discharge other duties, such as providing COLR service. In return, utilities receive some constitutional and statutory protections, including the opportunity to earn a reasonable return on net capital investment.

The franchise concept has deep historical roots. Early legislatures sometimes issued franchises to entrepreneurs to build a bridge or railroad or to provide a ferry service. The grantee would expend his private capital in pursuit of the public good and would usually receive an exclusive right for a period of years. In the 19th century, the franchise concept applied to such improvements as bridges and turnpikes.[264] In the 20th century, franchising became a cornerstone of utility law.

A franchise is a bargain between the state and the entrepreneur. The utility/developer gains an economically useful opportunity, which usually amounts to exclusivity over a market. The state gains private capital to use in the improvement of an essential service. Franchises historically always produced only one "winner" in each area.[265]

B. The FCC's Identical Support Rule

For almost 20 years, a central concern of the FCC has been avoiding the need to pick winners by allocating universal service support. The Telecommunications Act of 1996 articulated several broad principles for USF programs. In 1997, the FCC adopted "competitive neutrality" as a supplemental principle, explaining that government policy should not favor one company over another or one technology over another.

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[264] Even earlier, it was applied to the settlement of colonies.

[265] Telephone franchises in Vermont were debatably nonexclusive. Electric distribution franchises are exclusive, giving only one electric utility the right to serve a given location. Electric generation has recently become more of a commodity.

To implement that new principle, the FCC in 1997 adopted the identical support rule. Under that rule, support was "identical," on a per-line-per-month basis, for each carrier serving a given geographic area. The amount in each area was determined by the characteristics of the ILEC serving that area.[266]

Even at the outset, the identical support rule failed to be neutral. It created two distinct methods for calculating support. For the ILEC, support was based on the ILEC's own cost. For CLECs serving the same area, support was based on the facts applicable to the local ILEC.

It took about ten years for the FCC to appreciate the problems created by the identical support rule. In that decade the rule spawned an entire industry of wireless carriers who provided service in states with high levels of federal USF support. In 2008 the FCC froze support under the identical support rule, acknowledging that the rule had begun to threaten the sustainability of universal service. The FCC said the rule had created incentives for competitive carriers to "expand the number of subscribers . . . rather than to expand the geographic scope of their network" into unserved or underserved areas.[267] In 2011 the FCC abolished the identical support rule.[268]

The most obvious flaw was that the identical support rule failed to extract a public benefit.[269] In trying above all to avoid picking winners, the FCC largely ignored whether USF funds achieved a useful purpose. As a result, the FCC support was increasingly allocated to carriers that built few or no facilities but that excelled at finding customers in areas with high levels of federal high-cost support.

For this reason, the identical support rule never maximized service in high-cost areas. Instead, it may have actually harmed ubiquitous service. The rule encouraged entry by competitors who shared the ILECs' market, thereby dividing customer revenues. If the rule did have any effect on universal service, it likely reduced the chance that a single provider could survive economically. It certainly increased the claims for universal service support.

Finally, the identical support rule was inefficient. The areas that need universal service support are precisely those in which private capital markets have judged to be too costly to

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[266] See 47 C.F.R. § 54.307.

[267] *High-Cost Universal Service Support*, WC Docket No. 05-337, Order, 23 FCC Rcd 8834, 8843, para. 21 (2008) (*Interim Cap Order*) (adopting an emergency cap on high-cost support for competitive ETCs).

[268] *Connect America Fund,* WC Docket No. 10-90, Report and Order and Further Notice of Proposed Rulemaking FCC 11-161, para. 296 (2011). The FCC did create a phase-down of existing support for these competitive carriers.

[269] The identical support rule created a separate but related problem. It created a vicious cycle that over time paid more and more for less and less. As incumbent carriers lost customers to CLECs and wireless carriers, the ILECs' average costs increased, increasing their need for federal USF support. But the rule gave the same raises to the competitors. The total demand inevitably grew exponentially, with increasing shares going to competitors, but with little or no demonstrable benefit.

support a ubiquitous network. The identical support rule devoted public funds to the dubious goal of encouraging *multiple* networks in these same high-cost areas.

C. Single Supported Carriers

With this history in mind, a middle ground is needed to address competitive neutrality. The identical support rule should be avoided. Yet it is reasonable to give all competitors an equal opportunity, provided they are willing to assume equal obligations. We recommend that VUSF high-cost payments in any geographic area be restricted to a single company that is the most qualified and likely to be an efficient provider of the benefits that Vermont wants to acquire. The single supported carrier could be either the ILEC or a competitor.

A competitively fair high-cost mechanism should give all competitors equal opportunity to receive support, provided they assume equal service obligations. Vermont should restrict VUSF payments in any geographic area to a single provider.

D. Competitive Bidding

If Vermont wants to consider providing high-cost support to non-ILECs, one approach is competitive bidding. Many state and federal policymakers over the years have expressed enthusiasm for competitive bidding, which is sometimes called an auction because providers submit bids for USF support.[270]

The principal advantage of auctions is that they are facially neutral. ILECs, CLECs, and wireless providers may all apply. In reality, the auction rules may effectively disqualify one or more plausible bidders unintentionally or even surreptitiously through technical requirements. These details can reduce or even neutralize the facial neutrality benefit.

Another advantage of auctions is that they can be easily tailored to a program budget. The FCC has conducted auctions recently that have offered fixed amounts of funding nationally.

The details of running a USF auction are complex, and there are many ways to fail. An auction may not generate any bidders. Bids may be too high to accept. Bidders may not be suitably qualified. Finally, bidders may make implausible assumptions about their ability to continue to rely on an ILEC's network, such as for backhaul.

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[270] Sometimes they are called reverse auctions because the winning bidder submits the lowest bid rather than the highest.

Auctions have been widely used throughout the world, but in limited circumstances that are mostly not relevant in Vermont. They have been most successful selecting a provider for a third-world area that lacks telecommunications and where interconnection issues are minor. They have not been used successfully, to our knowledge, in any areas with established ILECs whose facilities are expected to support a competitor who wins the auction.

The FCC has long supported competitive bidding, but its track record in recent experiments has been mixed. In a recent CAF I round of grants, bids were simply not submitted for some states that have high-cost unserved areas, and only about half of the offered money nationally was actually awarded. This experience suggests that auctions are moderately effective at spending money but not effective at ensuring continuation of ubiquitous quality telecommunications.

So far as we are aware, no state has actually conducted an auction that involves transferring COLR-like responsibilities and USF support from an ILEC to a competitor. Where a state utility commission has announced plans to conduct competitive bidding and auctions for universal service, the state typically conducts some preliminary working sessions to determine the rules for the auction, but the auction itself never occurs.[271]

In sum, auctions are complex and risky, and they have not been shown to be useful vehicles for allocating state USF support in an environment with established interdependent networks and COLR obligations. We do not recommend that Vermont pursue auctions further as a potential support mechanism.

On the other hand, Vermont has better reason than many states to consider an auction process to identify VUSF support recipients. Vermont has made financial commitments to a wireless broadband provider that has promised to provide service over a wide swath of the state. We also understand that Vermont has several localized broadband providers, both wireless and wireline. This diversity generates at least the possibility of a productive auction. If Vermont does want to proceed to competitive bidding, it should take the following preliminary steps:

- The Legislature should answer the key questions identified above in Section IV, including providing a definition of the "essential service" and defining the degree that "availability" means 100% coverage.
- The Legislature should define the auction rules, such as whether there is a winner-take-all result or some allocation of service areas to multiple bidders.
- The Public Service Board should conduct a proceeding to define the boundaries of the service areas to be auctioned as units.
- The Public Service Board should, subject to legislatively prescribed standards, conduct a proceeding to define the minimum technical specifications of the service to be covered by the bids.

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[271] At various times, New York, California, and Maine have expressed interest in using auctions.

- The Public Service Board should, subject to legislatively prescribed standards, conduct a proceeding to establish the rules by which a winning non-ILEC bidder will transition customers from service by the ILEC to service by the bid winner. This may involve a process for identifying ILEC assets that the bid winner will acquire by eminent domain from the ILEC and a process for completing eminent domain acquisition before support begins for the auction winner.

Vermont should reject auctions as a potential support mechanism. If, however, Vermont does proceed to authorize auctions, it should take several preliminary steps to better define the terms of and rules for conducting those auctions.

E. Challenges for COLR Support

A final option to avoid picking winners is to allocate support initially to ILECs, but then allow telecommunications providers at any point to challenge eligibility for future years. A competitor would file a challenge at the Public Service Board seeking to supplant the ILEC. If the PSB rules the challenge successful, the new competitor would supplant the ILEC as the single VUSF recipient.

A challenge petition would require consideration of a number of factors:

- Whether the challenger is suitably qualified technically, is financially sound, and has a good business reputation.
- Whether the challenger has a plausible plan to provide essential service that would satisfy the state's objectives, including broadband speeds and ubiquity.
- What services, if any, the challenger proposes to purchase from the ILEC, such as special access or Ethernet services, and the probability that those services would continue to be available if the challenge is successful.
- What assets, if any, the challenger proposes to acquire from the ILEC through eminent domain.
- The likely effect on the size of the VUSF fund if the petition is granted.

We recommend that Vermont consider this challenge option. The poor economics of building parallel networks in rural areas probably means that challenges would be infrequent. Even if no challenge is ever filed, however, Vermont will at least have established a mechanism to deal with the competitive neutrality issue.

Vermont should consider establishing a procedure by which support can be transferred to a single successful challenger who would displace the ILEC and be subject to standard COLR obligations.

VII. Conclusion

In 2012 the Vermont Legislature posed several questions for this study. Answering them has been a long and complex process involving several months and over 150 pages of written reports. RLSA has been honored to participate in this important process, in which the Vermont Legislature begins to grapple with the complexities of the new competitive telecommunications landscape. The single most important message is that telecommunications services in the near future may look quite different from those to which lawmakers have become accustomed.

In Volume I of this trilogy, we found that the FCC's recent *USF/ICC Transformation Order* created serious financial problems for the Vermont ILECs. Individual companies aside, however, the FCC's actions were only one of many events likely to reduce ILEC revenues and create financial instability. In Volume II we forecast the overall financial position of the Vermont ILECs, and we found that nearly all stand to lose money this year and in the immediate future, both on a regulated activities basis and on an all-in basis. We saw no basis to conclude that gloomy picture was likely to change.

Volume III describes how Vermont might address these problems. Before Vermont selects a tool for a high-cost support mechanism, we strongly encourage articulating goals for that program and deciding a number of threshold policy issues. The support mechanism Vermont ultimately selects should match both those desired ends as well as the financial means at hand.

We hope the three volumes of this report have provided sufficient information that Vermont policymakers can efficiently structure their debate on creating a high-cost support mechanism.

Appendix A – Retail Bill Comparison[i]

Type of Service	FairPoint	Comcast	Verizon Wireless mobile products	Verizon Wireless Home products	Walmart Straight Talk
Basic voice (dial tone) service [ii]	$23 [iii]	$36 [iv]	$37 [v]	$20 [vi]	$15 [vii]
Basic and long-distance voice[viii]	$67 [ix]	$47 [x]	$53 [xi]	$20 [xii]	$15 [xiii]
Basic and long-distance voice and 3 Mbps Internet with 10 Gigabits of actual data usage [xiv]	$66 [xv]	$76 [xvi]	$142 [xvii]	$110 [xviii]	-
Basic and long-distance voice and 3 Mbps Internet with 50 Gigabits of actual data usage	$66 [xix]	$76 [xx]	$417 [xxi]	$355 [xxii]	-

[i] The table shows only nominal rates, rounded to the nearest dollar. It includes surcharges imposed on customer bills related to all federal programs, including subscriber line charges (SLCs), access recovery charges (ARCs), federal USF surcharges, federal TRS surcharges, federal regulatory fees, and federal excise taxes. It excludes Vermont VUSF surcharges and the Vermont sales tax, and it disregards introductory discounts. Where a customer must have specialized equipment (modem or wireless transmitter/receiver) in order to utilize the service, the table assumes the customer has chosen to purchase rather than rent that equipment.

[ii] The data in this row shows each provider's lowest-priced stand-alone voice product. As indicated in subsequent rows, some providers offer lower prices when voice services are bundled with other services.

[iii] The amount shown is $14.00 for FairPoint's low-use service, plus subscriber line charge of $6.22, an access recovery charge of $0.73, a federal excise tax of $0.66, and a federal USF surcharge of $1.05. Low-use customers may prepurchase fixed-size bundles of local usage minutes at a discount of 15%. Monthly local usage rates are capped at $39.40. Fairpoint e-mails of July 2, July 8, and September 6, 2013.

[iv] The amount shown is $34.95 for stand-alone Xfinity Voice – Local with More, plus $1.07 for federal excise tax. Lower prices are available for customers who purchase bundled service packages that include

Internet or television. A modem rental charge of $7.00 per month is excluded. Comcast letters of June 27, July 10, August 23, and September 3, 2013.

[v] The amount shown is $35.00 for Verizon Wireless's basic prepaid minutes plan, plus $0.21 regulatory charge, plus $0.90 administrative charge, plus $1.30 for recovery of the federal USF surcharge. The prepaid plan is the lowest-priced Verizon Wireless mobile product. It includes 500 "anytime minutes," which allows customers to make calls within the U.S. that, if placed on landlines, might be either local or toll calls. The prepaid plan also includes unlimited text and data.

Verizon Wireless prepaid plans have a requirement that the customer "replenish" prepaid minutes periodically, and many customers select the company's more costly but less burdensome postpaid plans. Prepurchased minutes expire according to a schedule that depends on the size of the prepurchase. For example, minutes purchased with a payment of $15.00 to $29.99 expire after 30 days. Minutes purchased with a payment of $100 or more expire after a year. http://www.verizonwireless.com/b2c/prepay/processPrePayRequest.do?type=ppmonthBASIC (accessed Sept. 24, 2013).

[vi] The amount shown is $20.00 for Verizon Wireless's Home Phone Connect product. There are no added monthly charges. Verizon Wireless e-mail of Sept. 19, 2013. Home Phone Connect requires a device that is provided without charge if the customer signs a two-year contract.

[vii] The amount shown is for Walmart's Straight Talk fixed wireless home phone product. There are no added monthly charges. The service provides unlimited local and long-distance calling and includes voicemail, caller ID, 3-way calling, call waiting, call forwarding, E911, and 411 at no extra cost. Customers must purchase a home device for $99.99. http://www.straighttalkhomephone.com (accessed Sept. 23, 2013). The Walmart service is not compatible with data services such as home security systems, fax machines, DVR services, credit card images, or medical alert systems. http://www.straighttalkhomephone.com/shop.php (accessed Sept. 24, 2013).

[viii] "Long distance" here means a service package that allows unlimited calling within the U.S.

[ix] The amount shown is $58.99 for FairPoint's Exchange Choice, a federal SLC charge of $6.22, a federal ARC charge of $0.73, and a federal USF surcharge of $1.05. The plan includes unlimited calling in the U.S. and Canada plus 3 features. FairPoint e-mails of July 2 and July 8, 2013.

[x] The amount shown is $44.95for stand-alone Xfinity Voice – Unlimited, plus $1.45 for a federal universal connectivity fee, and $0.21 for a portion of a regulatory recovery fee associated with federal TRS costs. (Comcast imposes the regulatory recovery fee on voice services to recover Comcast's contributions for federal, state, and municipal regulatory programs, including the federal TRS surcharge.) Customers taking this service can make unlimited calls within the U.S., Puerto Rico, U.S. territories, and Canada, and they receive 12 "features." Comcast letters of June 27, July 10, August 23, and September 3, 2013.

[xi] The amount shown is $50.00 for Verizon Wireless's Best Value prepaid plan, plus $0.21 regulatory charge, plus $0.90 administrative charge, plus $1.84 for recovery of the federal USF surcharge. The plan includes unlimited "anytime minutes" for calls within the U.S. The plan also includes unlimited text and data. Prepaid minutes expire as discussed above.

[xii] The amount shown is for Verizon Wireless's Home Phone Connect product. The advertised price is $20. There are no added monthly charges. Verizon Wireless e-mail of Sept. 19, 2013. Home Phone Connect requires a device that is provided without charge if the customer signs a two-year contract.

[xiii] See note vii above.

[xiv] The FCC has estimated that 2009 average wired broadband usage was 10 Gb per month and that annual per user growth has been between 30 and 35 percent. *USF/ICC Transformation Order*, ¶ 99. A more recent study shows mean usage on fixed access networks in North America at 44.7 Gb per month. Sandvine, *Global Internet Phenomena Report, 1H 2013,* p. 5, available at http://www.sandvine.com/downloads/documents/Phenomena_1H_2013/Sandvine_Global_Internet_Phenomena_Report_1H_2013.pdf. Since one HD movie occupies approximately 4 Gb of data space, a user who downloads 2.5 HD movies per month would use 10 Gb. A user who streams 4G video on a wireless network one hour per day (@ 350 Mb/hr) or who streams audio 5 hours per day (@ 60 Mb/hr) would use 10 Gb.

[xv] The amount shown is $57.99 for FairPoint's Double Play-Exchange Select/Standard service, plus a federal SLC of $6.22, a federal ARC of $0.73, and a federal USF surcharge of $1.05. Excluded is a charge of $3.00 per month for Internet modem rental. The plan includes unlimited calling in the U.S. and Canada, 3 features, plus Internet with 3 Mbps download. FairPoint also offers a product with a 15 Mbps download speed. FairPoint e-mails of July 2, July 8, and September 6, 2013.

[xvi] The amount shown is $44.95 for Xfinity Voice – Unlimited voice service plus $29.95 for Economy Plus Internet Service, $0.97 for a federal universal connectivity fee and $0.14 for a regulatory recovery fee. Customers taking this service can make unlimited calls within the U.S., Puerto Rico, U.S. territories, and Canada and receive 12 features. Comcast also offers an Internet Essentials program that offers stand-alone Internet service for $10 per month to households that have a child eligible to participate in the National School Lunch Program. Comcast letters of June 27, July 10, August 23, and September 3, 2013.

[xvii] The amount shown is $100 for Verizon Wireless's Share Everything plan, plus $40.00 for a smartphone, plus $0.21 regulatory charge, plus $0.90 administrative charge, plus $1.19 for recovery of the federal USF surcharge. The plan provides unlimited voice and text, plus 10 Gb of data.

[xviii] The amount shown is for $110.00 for Verizon Wireless's Home Fusion product. There are no added monthly charges. Home Fusion requires a device that is provided without charge if the customer signs a two-year contract. If the customer wants higher speed 4G service, the device costs $99.99, with a two-year contract. https://support.verizonwireless.com/support/faqs/WirelessService/faq_homefusion.html (accessed Sept. 24, 2013); Verizon Wireless e-mail of Sep. 19, 2013.

[xix] FairPoint's cost in this cell is the same as in the cell directly above because FairPoint does not impose additional usage charges for data.

[xx] Comcast's cost in this cell is the same as in the cell directly above because Comcast does not impose additional usage charges for data in Vermont. On May 17, 2012, Comcast dropped its 250 Gb data limit nationwide and announced that it would be designing new data usage plans for some markets. Comcast letters of June 27 and July 10, 2013. Comcast subsequently imposed data surcharges in Nashville and Tucson, but it has not imposed any in Vermont.

[xxi] The amount shown is $375.00 for Verizon Wireless's Share Everything plan, plus $40.00 for a smartphone, plus $0.21 regulatory charge, plus $0.90 for an administrative charge, plus $1.19 for recovery of the federal USF surcharge. The plan covers unlimited voice and text, plus 50 GB of data.

[xxii] The amount shown is $355 for Verizon Wireless's Home Fusion product. There are no added monthly charges. Verizon Wireless e-mail of Sep. 19, 2013. See note xviii above regarding the required devices for Home Fusion.